

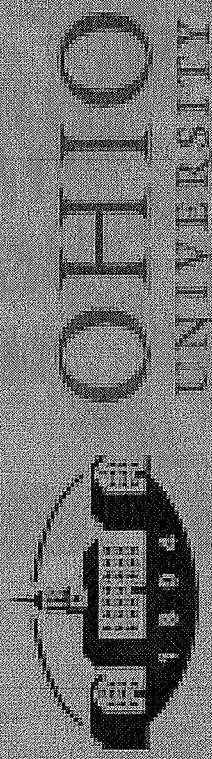
Abstract

NASA Technologies for Product Identification

by

Fred Schramm
NASA Marshall Space Flight Center
Engineering Directorate

Since 1975 bar codes on products at the retail counter have been accepted as the standard for entering product identity for price determination. Since the beginning of the 21st century, the Data Matrix symbol has become accepted as the bar code format that is marked directly on a part, assembly or product that is durable enough to identify that item for its lifetime. NASA began the studies for direct part marking Data Matrix symbols on parts during the Return to Flight activities after the Challenger Accident. Over the 20 year period that has elapsed since Challenger, a mountain of studies, analyses and focused problem solutions developed by and for NASA have brought about world changing results. NASA Technical Standard 6002 and NASA Handbook 6003 for Direct Part Marking Data Matrix Symbols on Aerospace Parts have formed the basis for most other standards on part marking internationally. NASA and its commercial partners have developed numerous products and methods that addressed the difficulties of collecting part identification in aerospace operations. These products enabled the marking of Data Matrix symbols in virtually every situation and the reading of symbols at great distances, severe angles, under paint and in the dark without a light. Even unmarkable delicate parts now have a process to apply a chemical mixture called Nanocodes™ that can be converted to a Data Matrix. The accompanying intellectual property is protected by 10 patents, several of which are licensed. Direct marking Data Matrix on NASA parts virtually eliminates data entry errors and the number of parts that go through their life cycle unmarked, two major threats to sound configuration management and flight safety. NASA is said to only have people and stuff with information connecting them. Data Matrix is one of the most significant improvements since Challenger to the safety and reliability of that connection. This presentation highlights the accomplishments of NASA in its efforts to develop technologies for automatic identification, its efforts to implement them and its vision on their role in space.



2006

AUTOMATIC IDENTIFICATION & DATA CAPTURE
TECHNICAL INSTITUTE

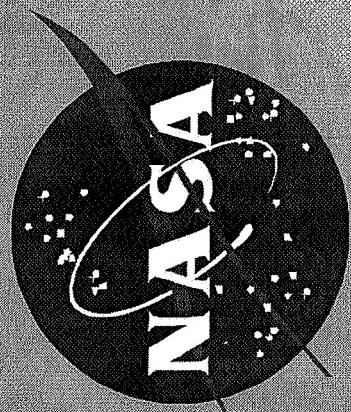
NASA Technologies for Product Identification

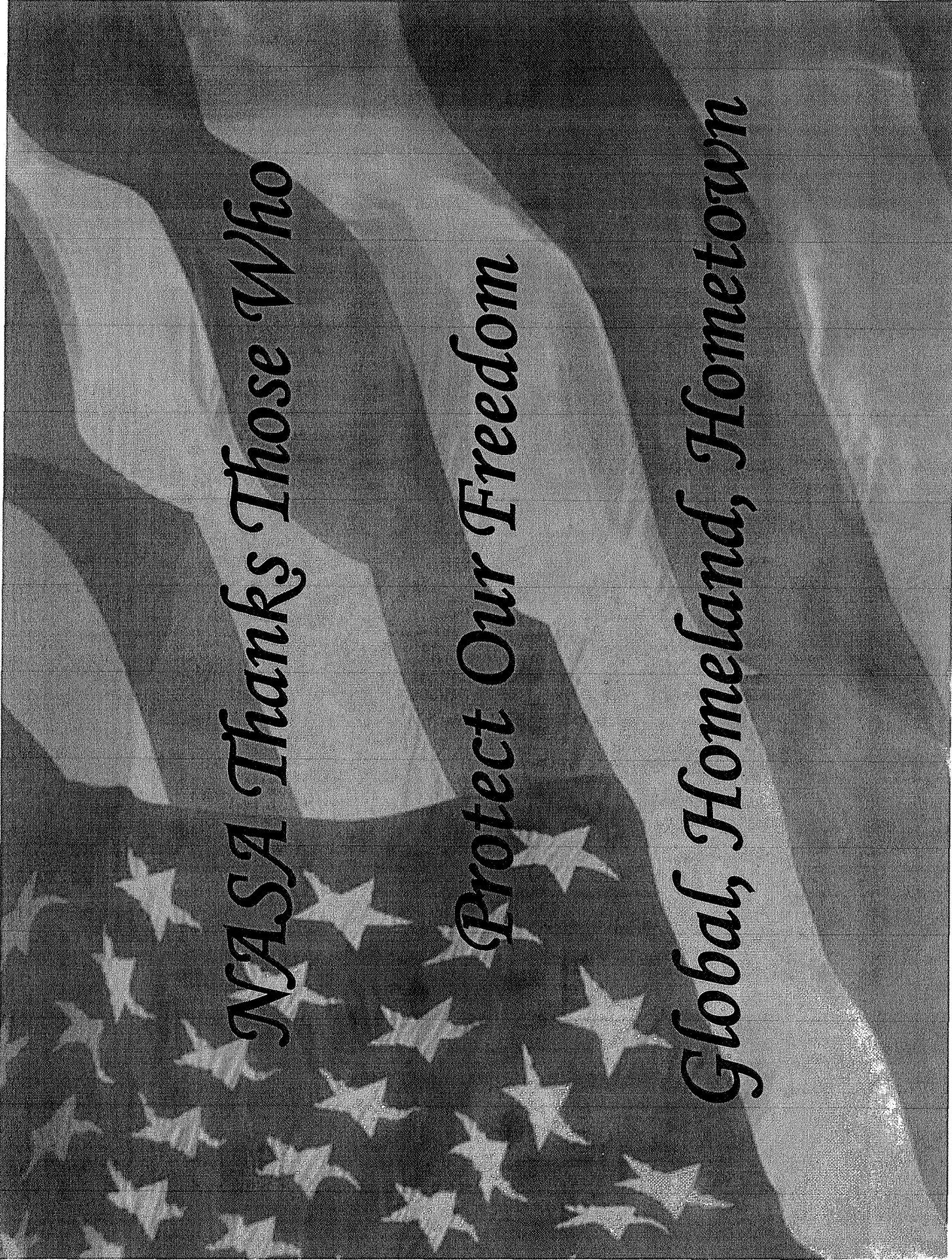
Fred Schramm

Engineering Directorate

NASA Marshall Space Flight
Center

July 28, 2006

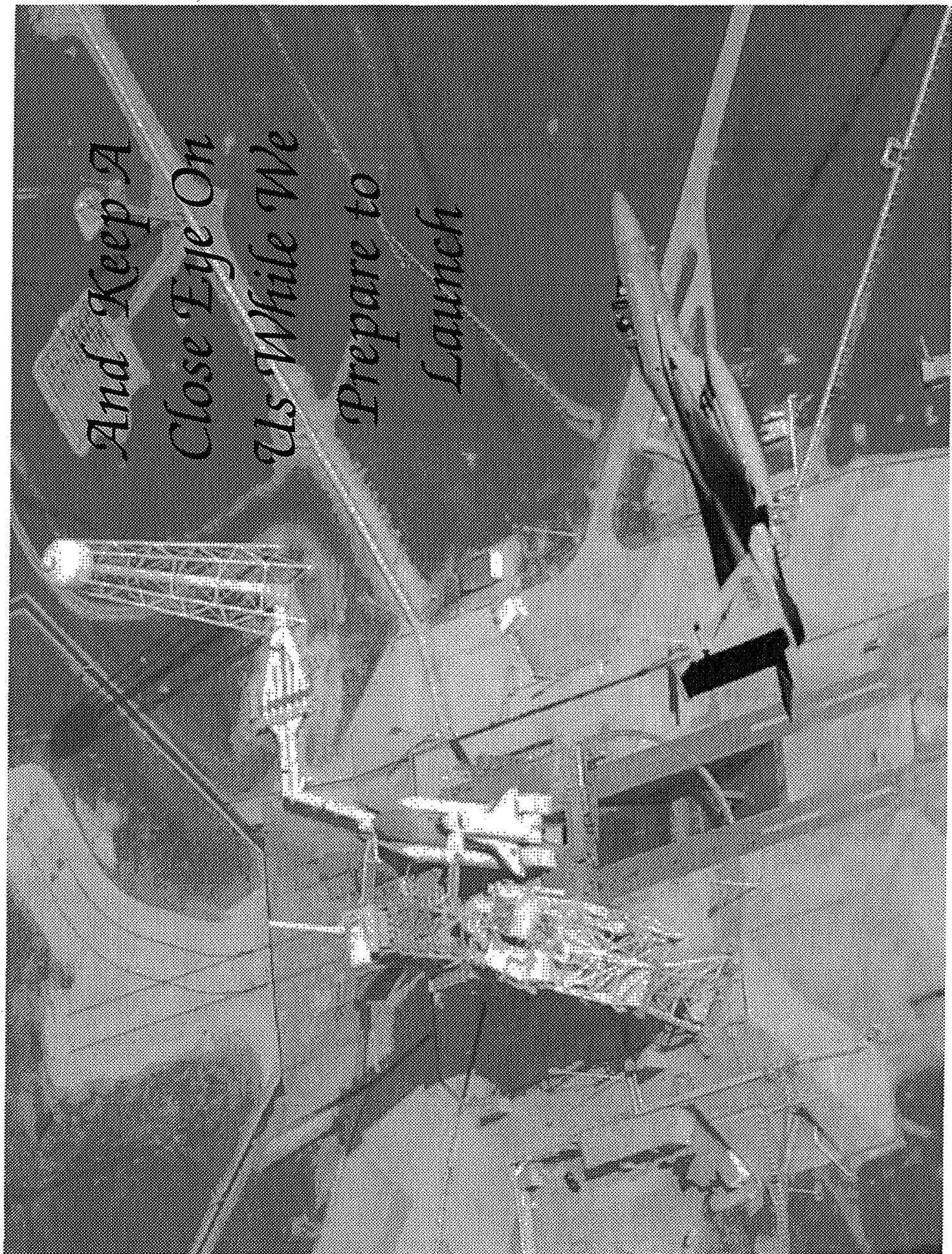




*NASA Thanks Those Who
Protect Our Freedom
Global, Homeland, Hometown*

And keep a
close eye on
us while we

Prepare to
Launch

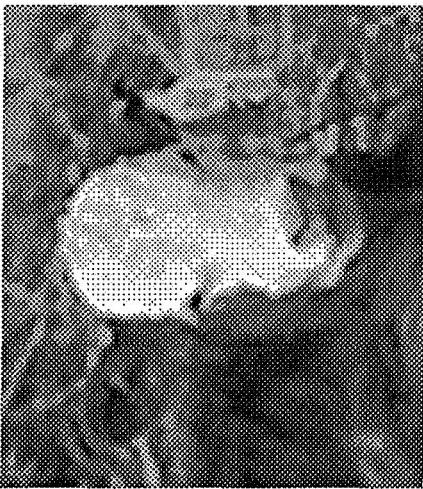
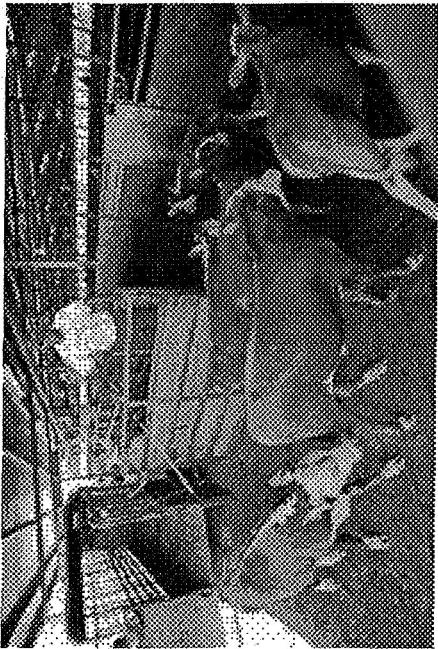


Today's World...More Things Being Tracked... Even the Food Supply

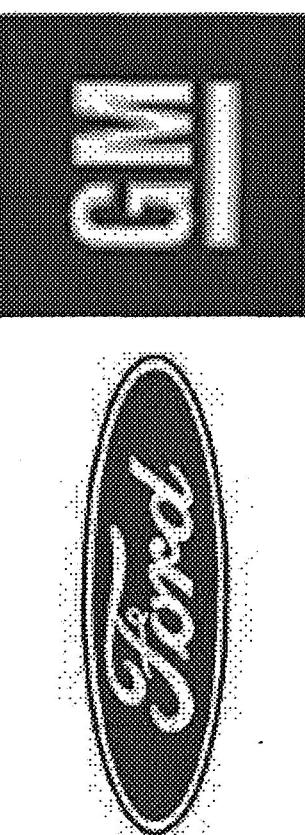


United States Department of Agriculture

**NEW NATIONAL ANIMAL ID SYSTEM
WILL GUARD AGAINST MAD COW DISEASE
AND ANIMAL HEALTH PROBLEMS**



Different Organizations Track Parts for Different Reasons

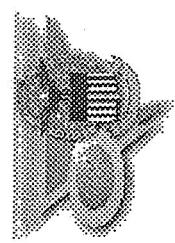


DAIMLER CHRYSLER

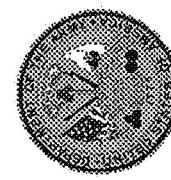
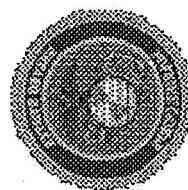
*Configuration
Management*

TREAD ACT

*Configuration
Management*



Readiness



UID

The Perfect Storm

TRREAD Act
Early Warning
Reporting



November 1, 2000

Transportation Recall Enhancement, Accountability, and Documentation Act (TRREAD Act)

Ford Aware of Venezuela Tire Defect in 1998

■ Safety: The auto maker and Bridgestone Firestone also are under fire from the Florida attorney general.

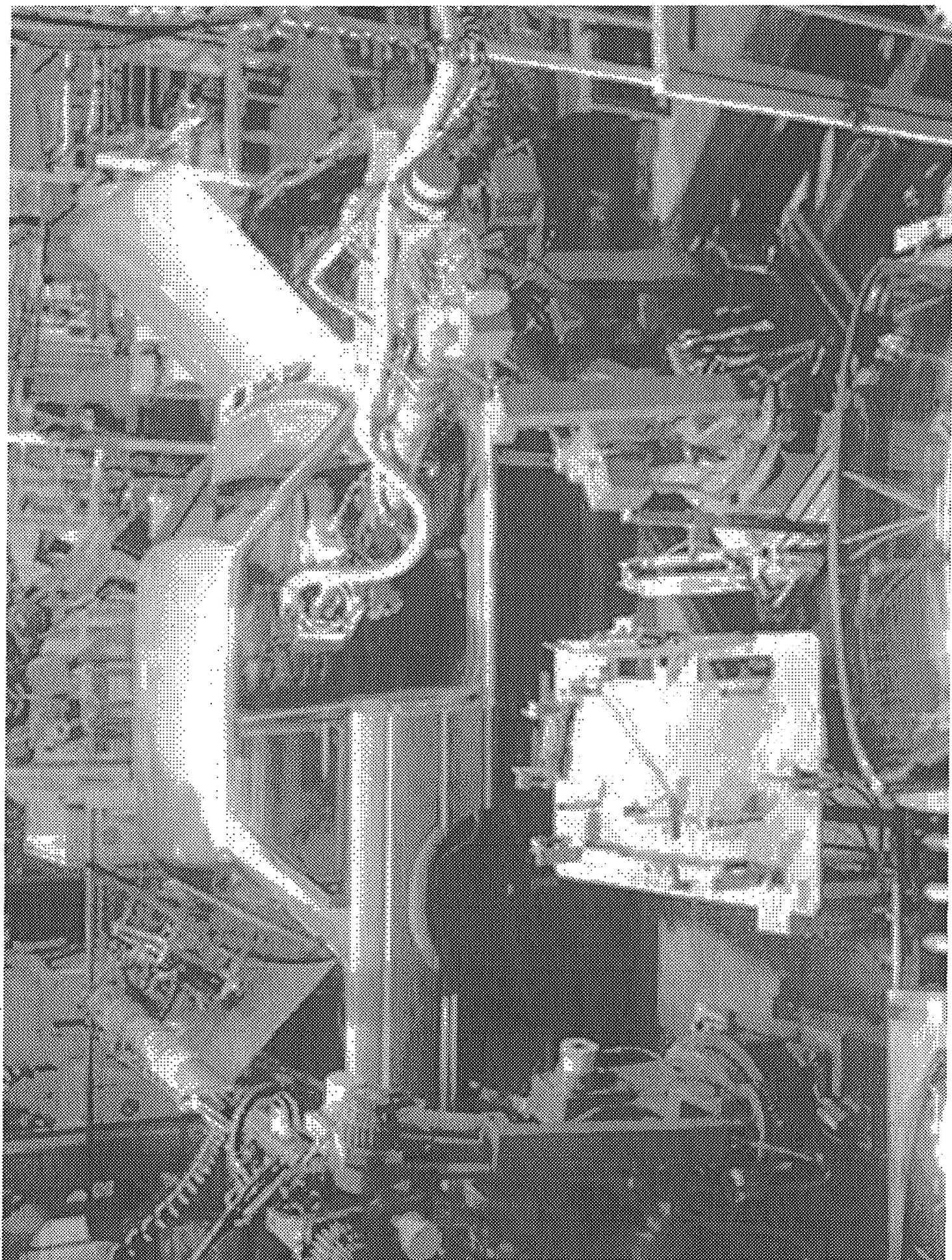
Front Page News/Staff Report

By JEFFREY M. PHILLIPS—Ford Motor Co. said Tuesday that its first report of problems with Firestone tires in Venezuela probably predates its Venezuelan recall in 1998—two years before it began replacing

Ford Hid Data On Tire Safety, Records Show

■ Safety: The auto maker and Bridgestone Firestone also are under fire from the Florida attorney general.

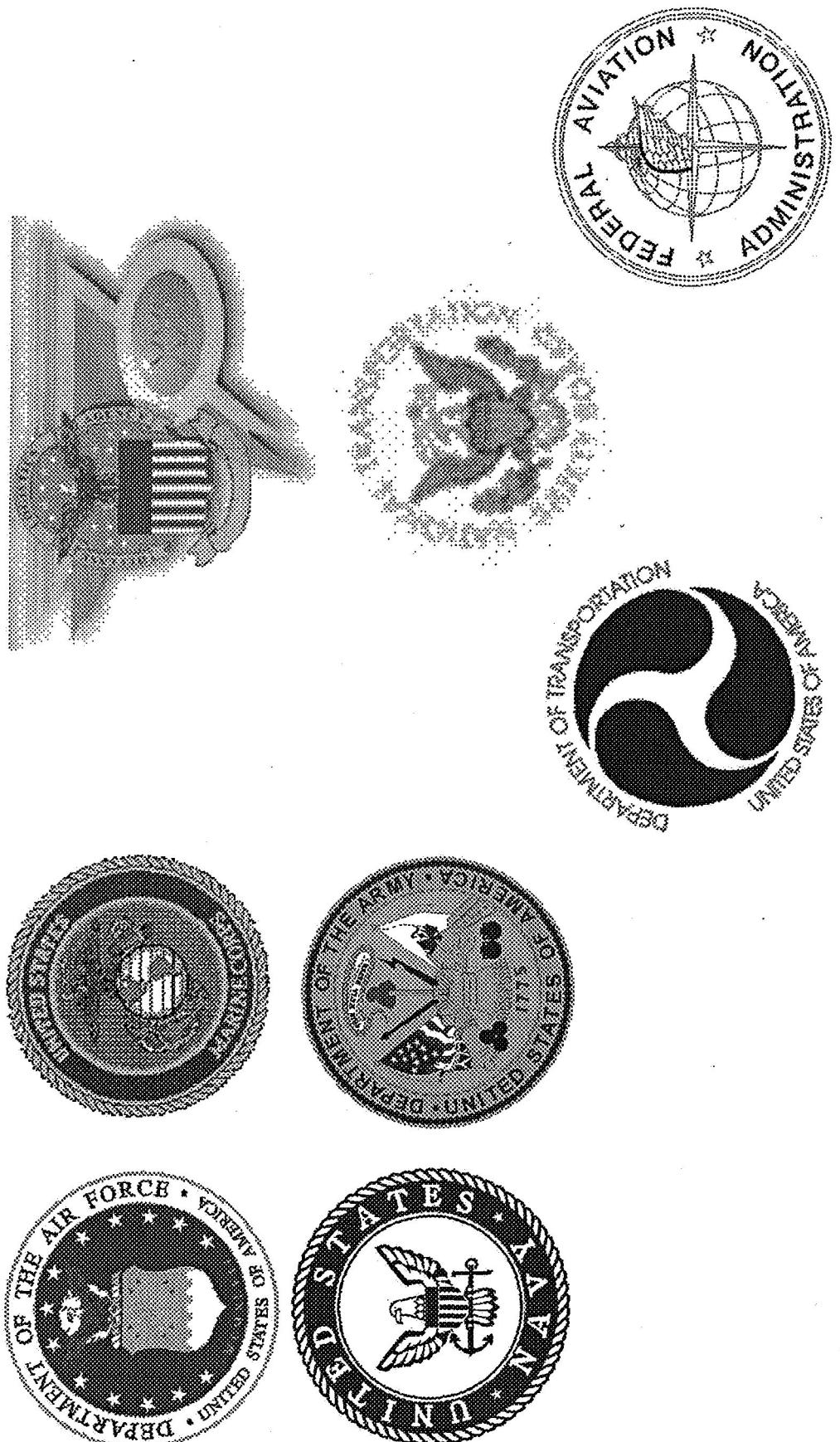
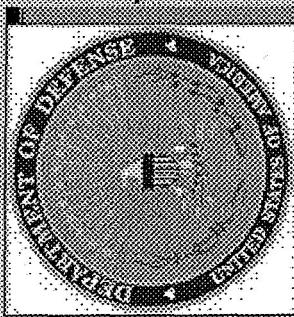
Front Page News/Staff Report



Automobile without TREAD Act



Unique Item Identifier (UID)

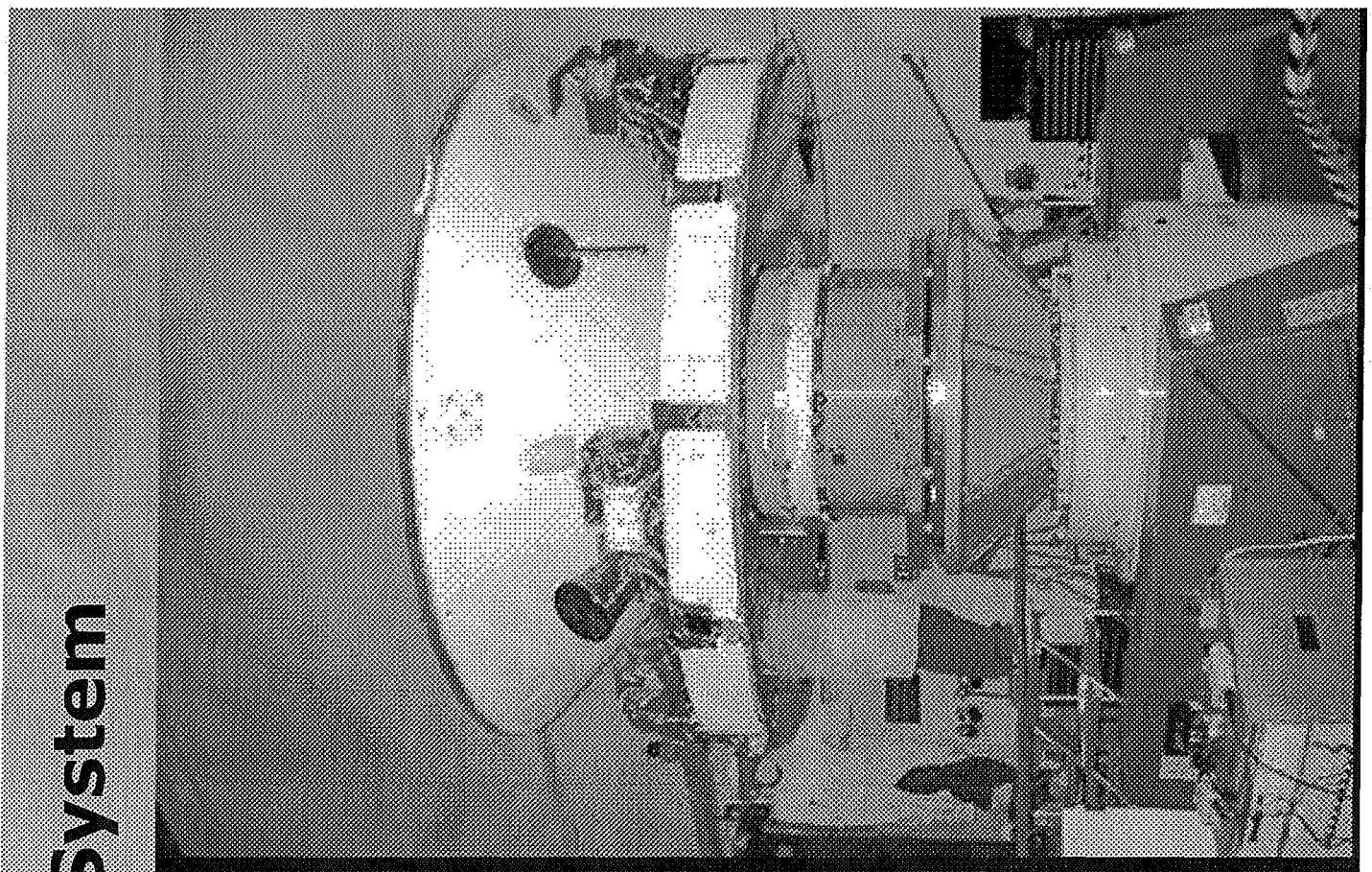
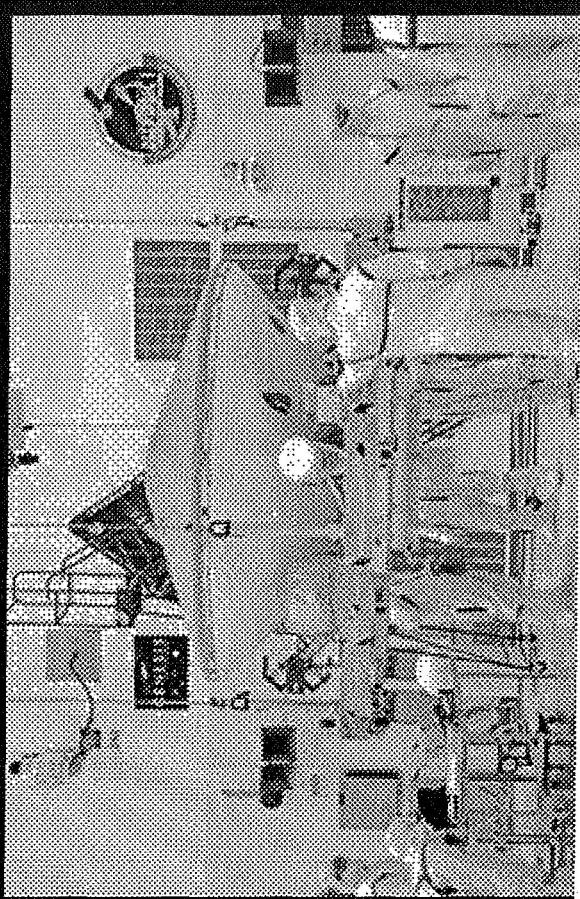
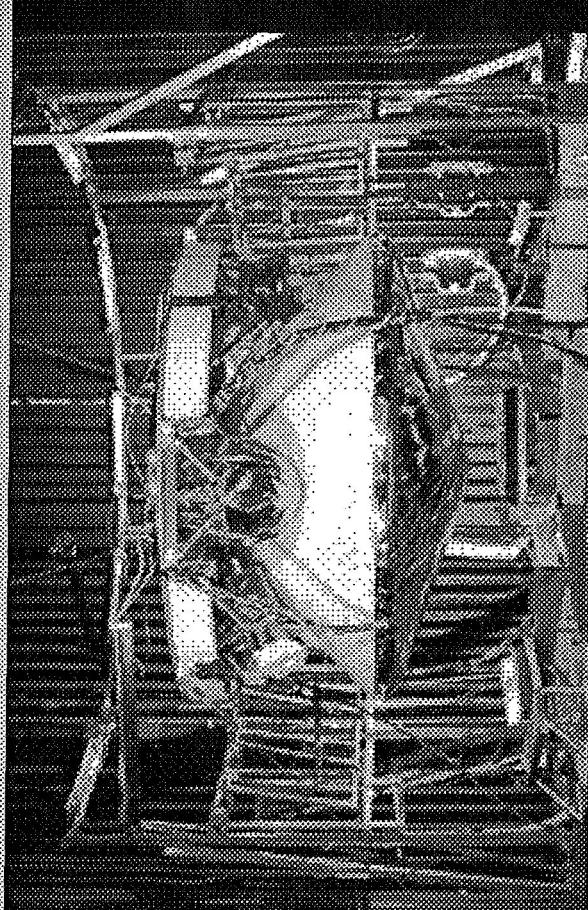


An Impossible Recall

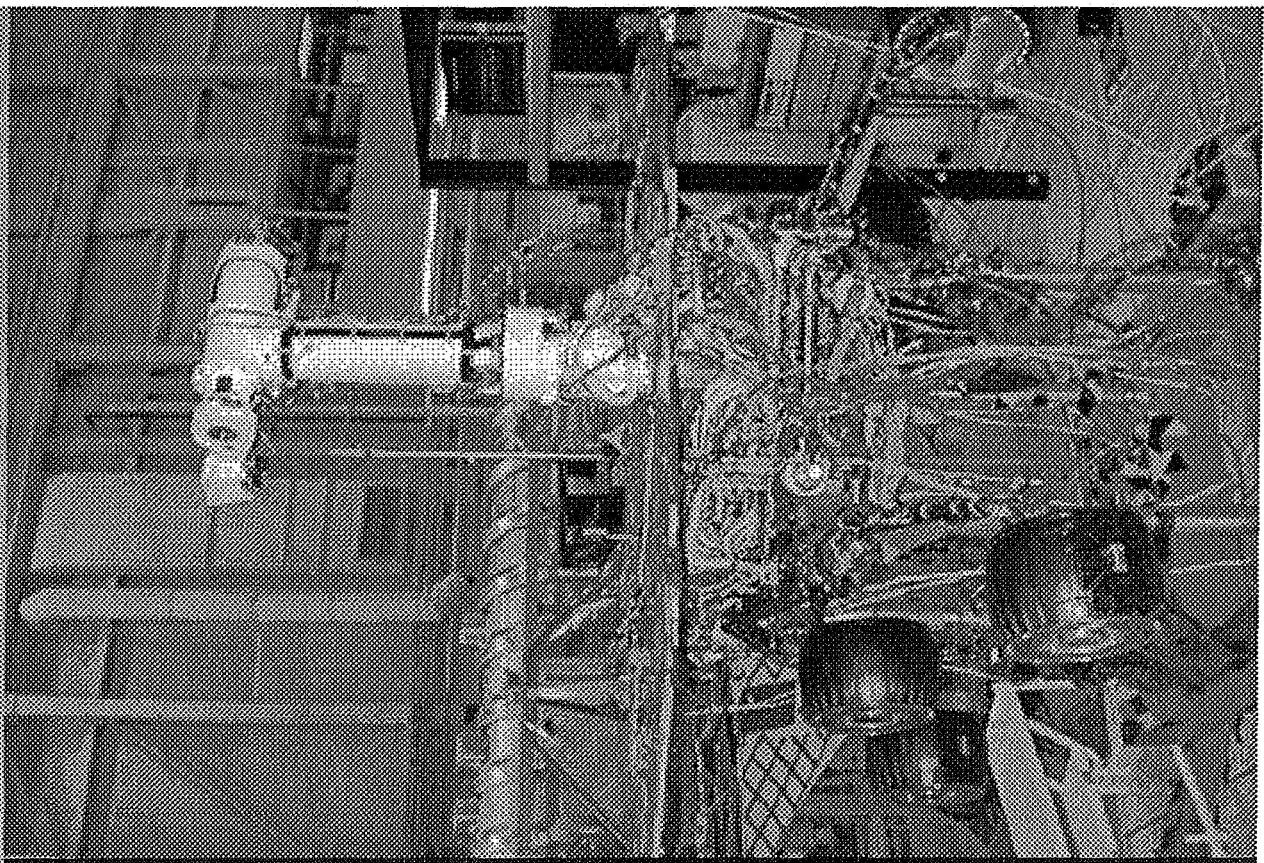
NASA's Recent Venture

Tire Tracks on Mars

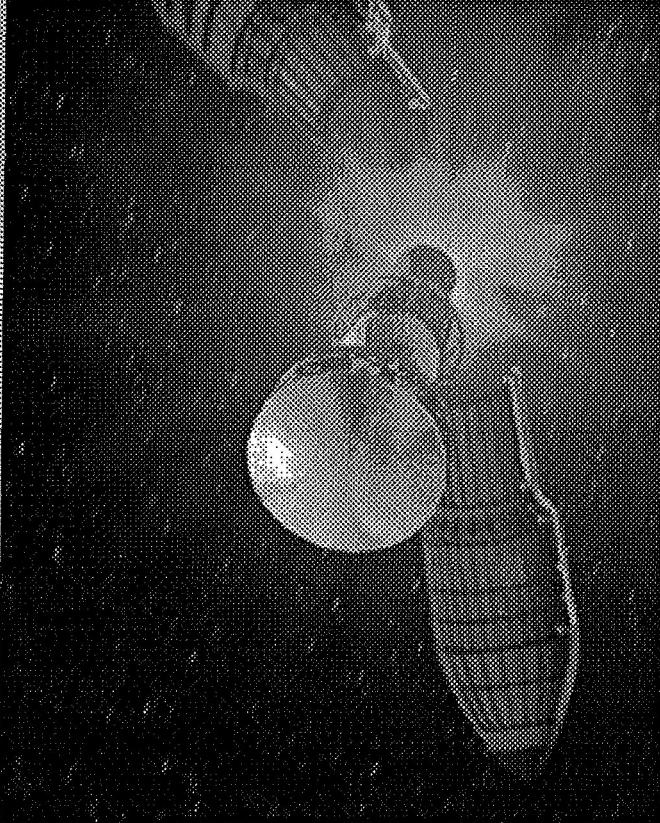
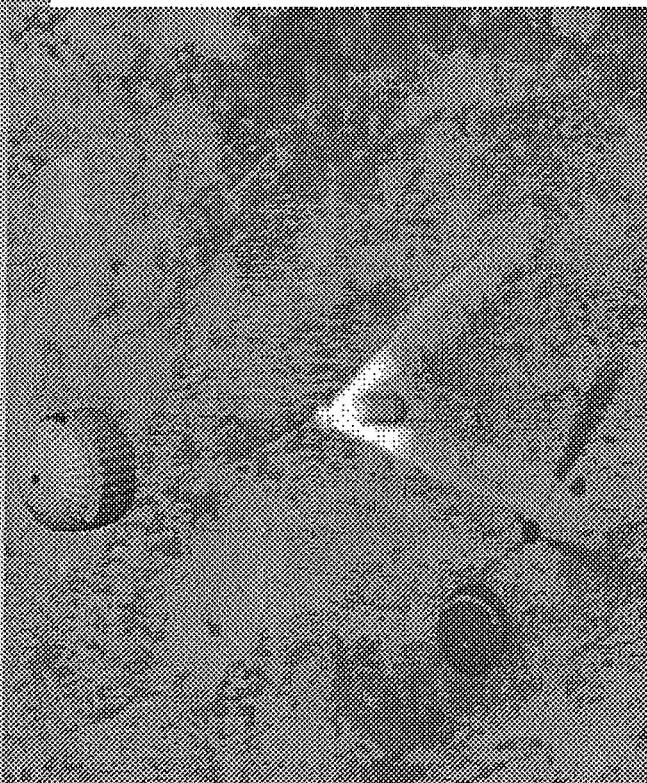
Delivery System



New SUV Was Produced



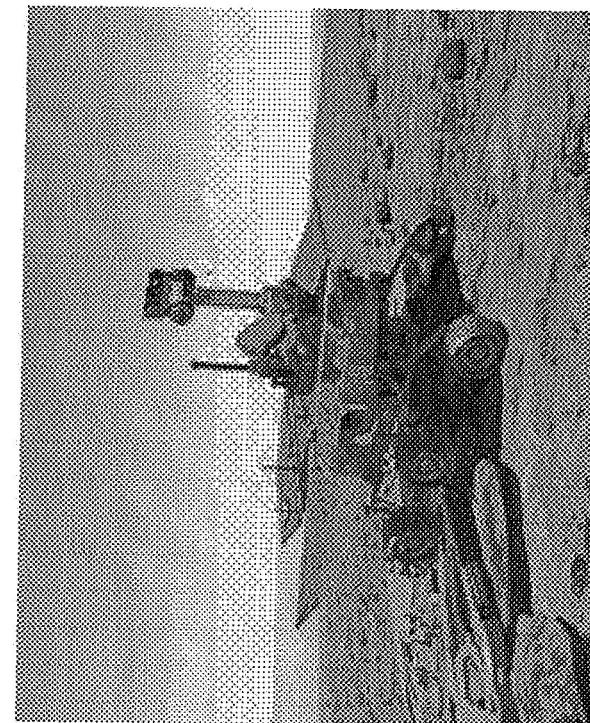
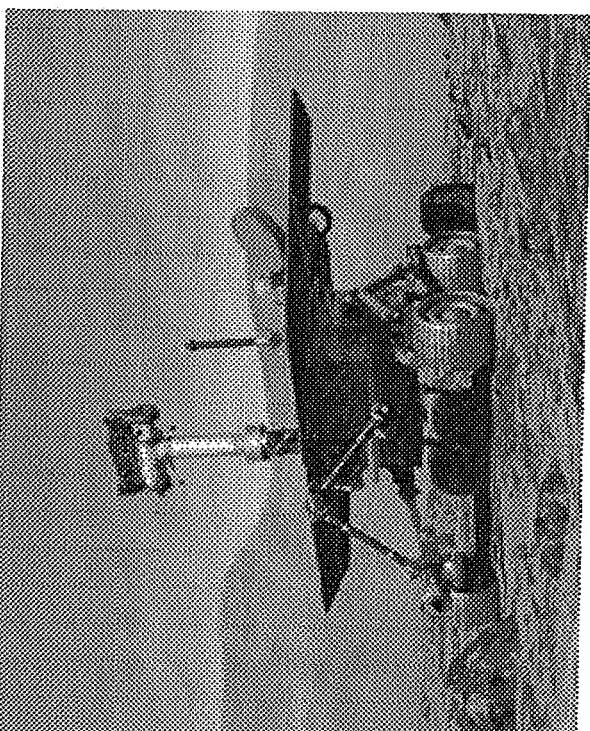
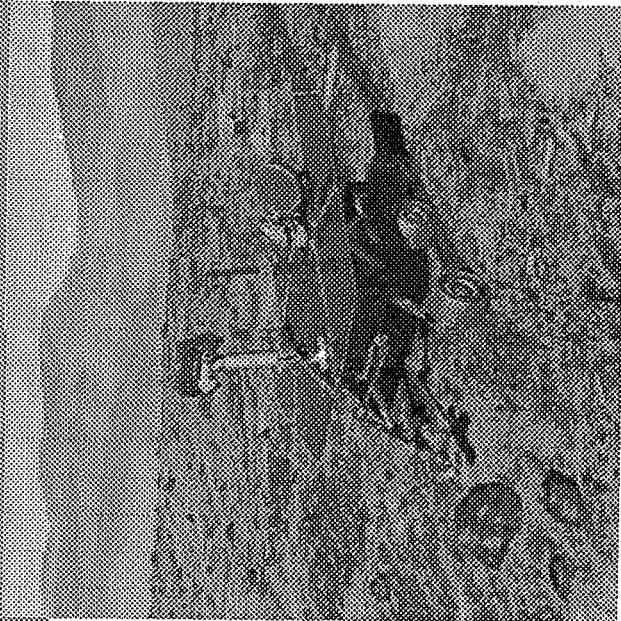
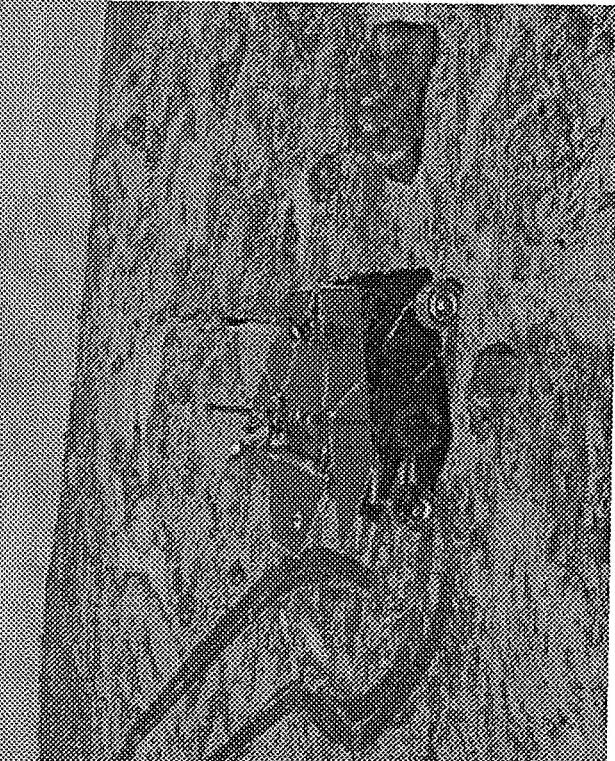
New Brake System



New Shocks, Too

Use Once and Discard

Catchy Name—Mars Rover “Land Rover” and “Range Rover” Already Used



Traceability of Critical Parts Why It Is Important To NASA

- Design Safety Factor of 1.4+
- Continued Testing to Validate Safety Factor
- Fleet Leader Condition (What Is Failing)
- Where Are All the Parts Like the Failed One
- How Do Only the Bad Ones Get Replaced

Traceability of Critical Parts Test for Life Extension

Learn to Test
Test to Learn

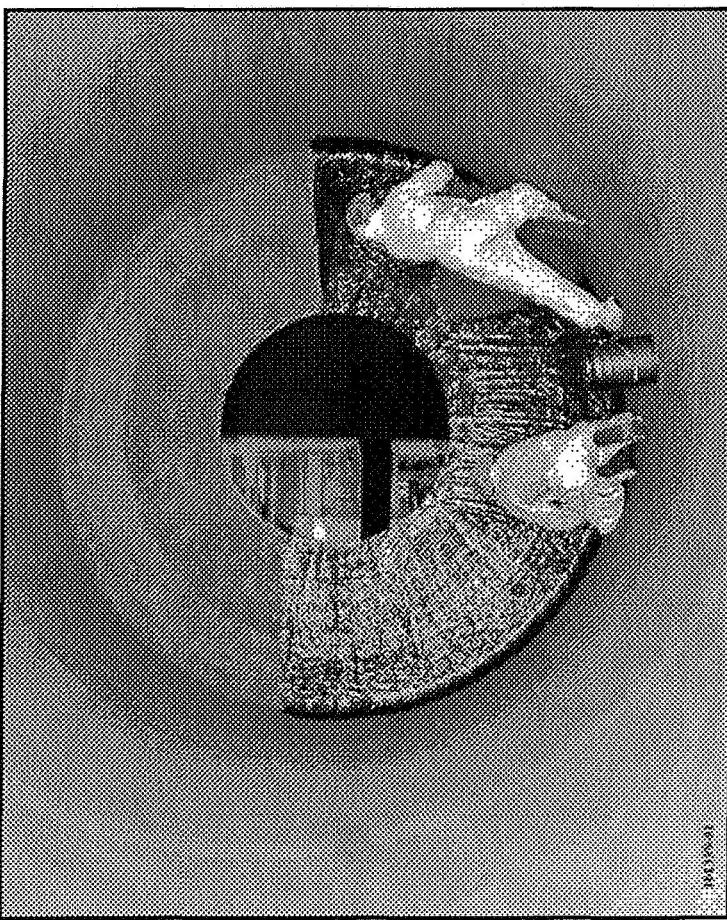
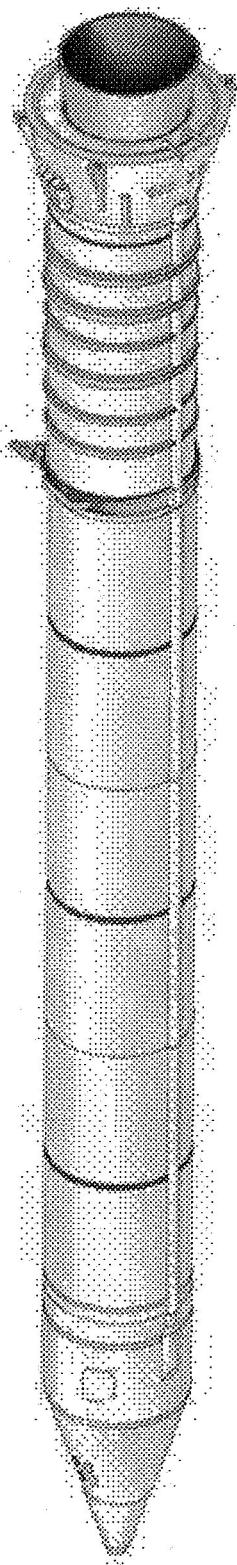
Failures Provide
Recall Information

This and other RSSM information compliments of:

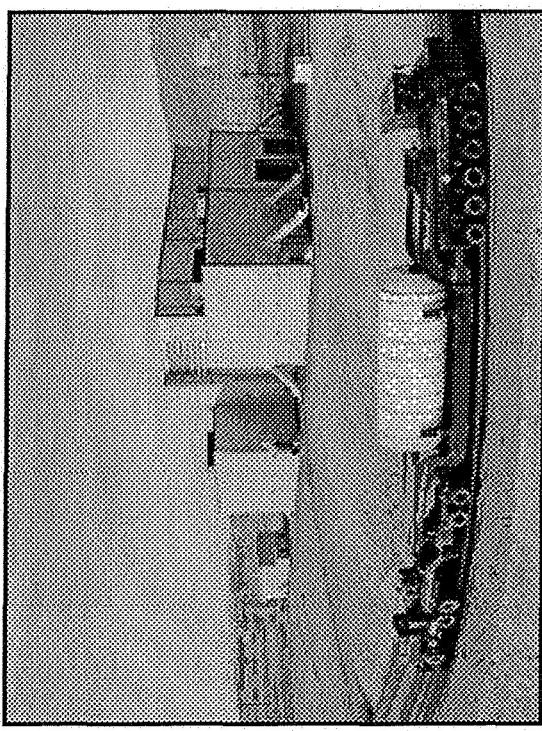
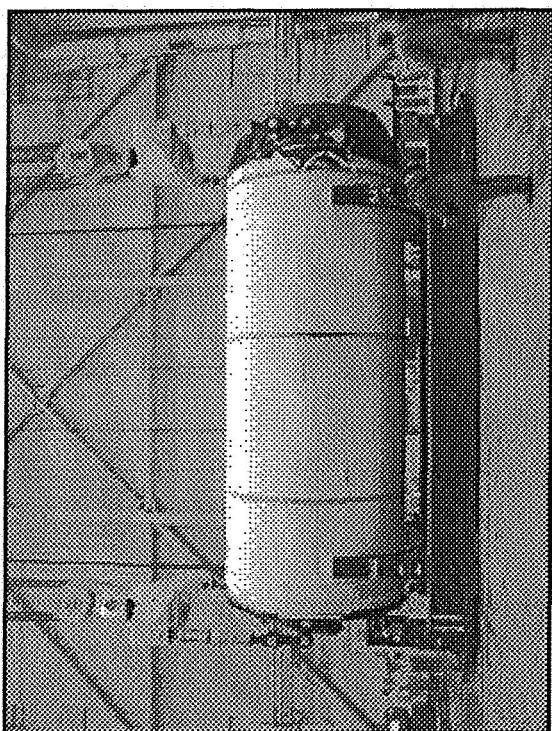
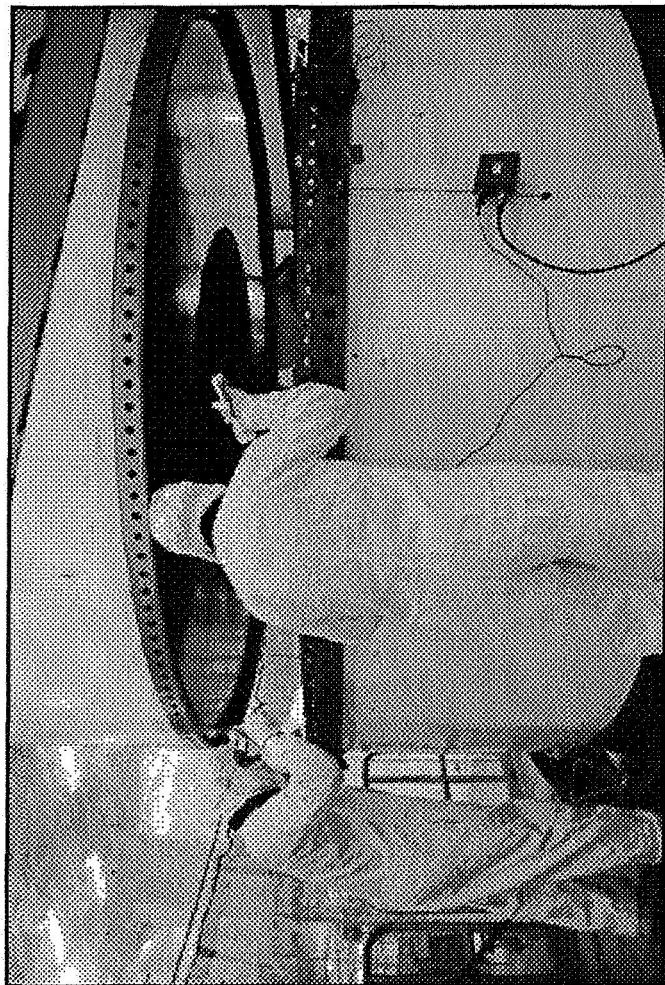


Traceability of Critical Parts

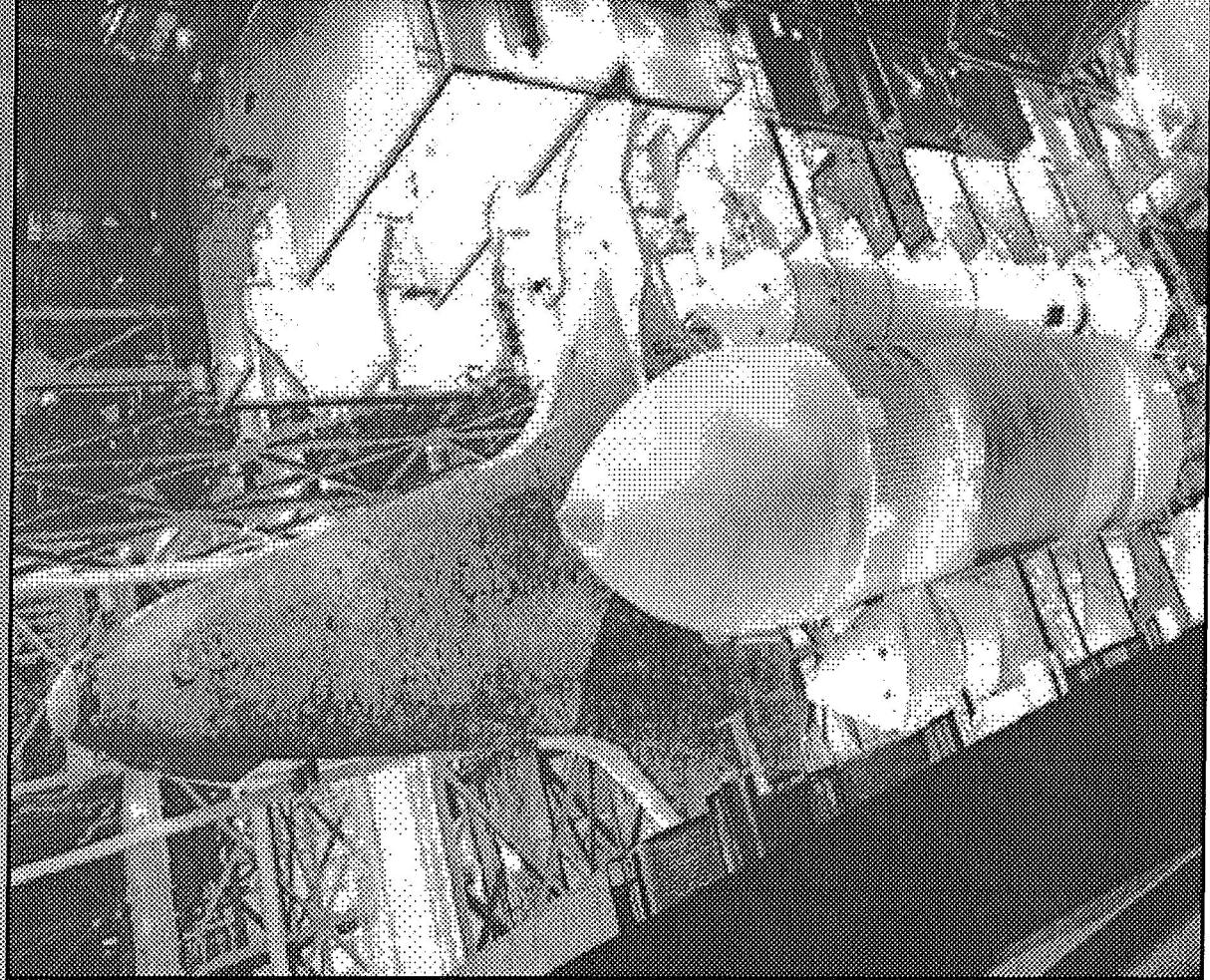
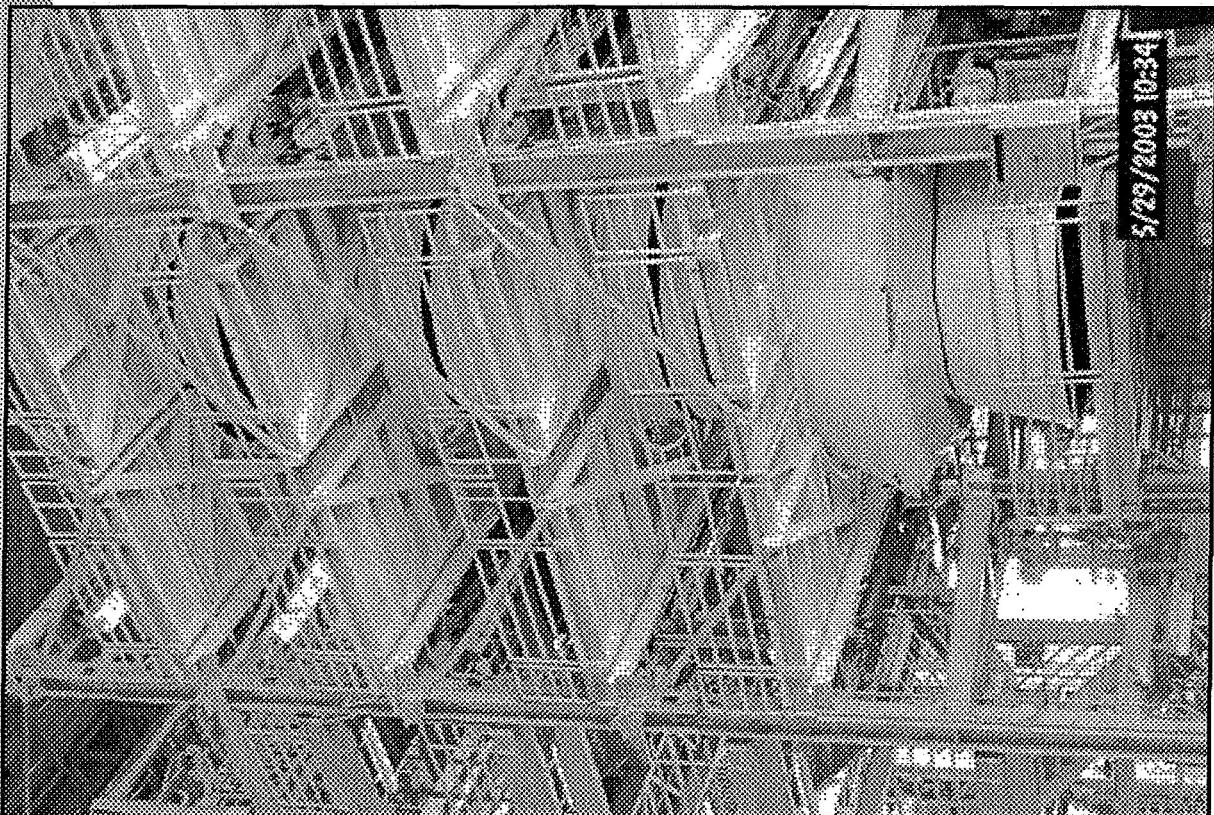
Reusable Solid Rocket Motor



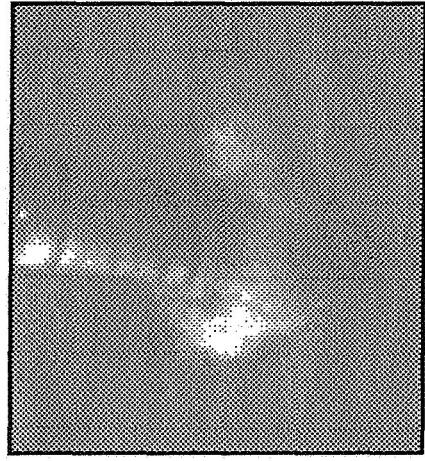
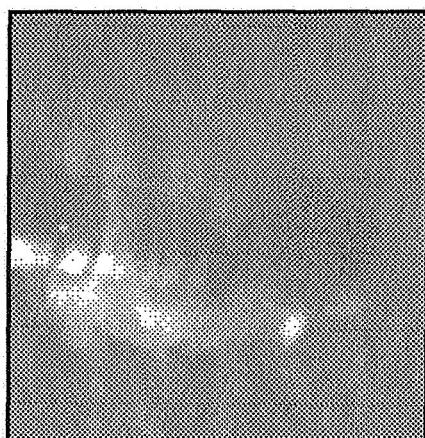
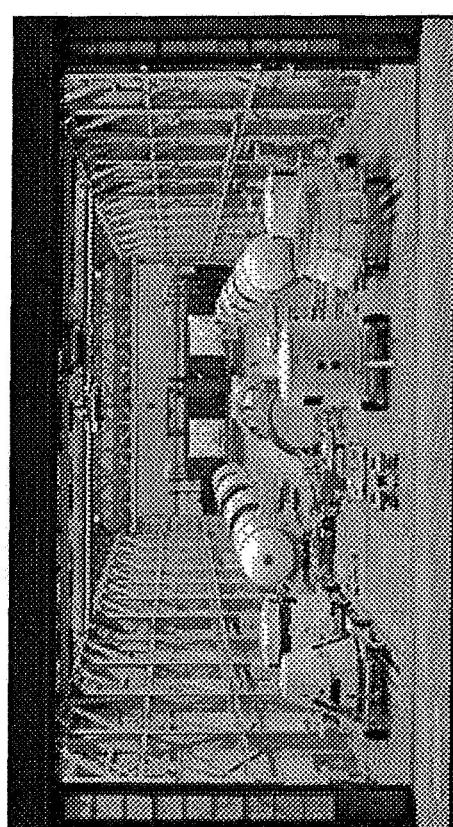
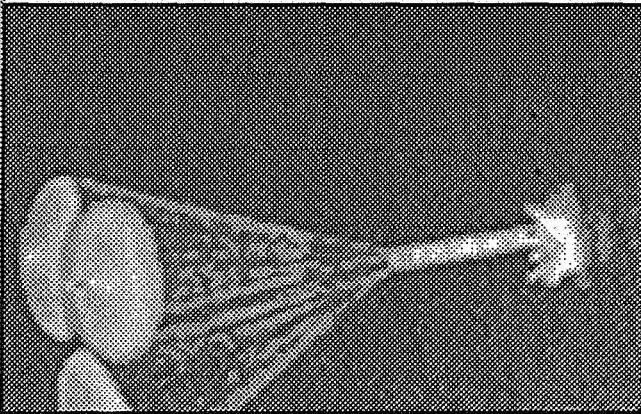
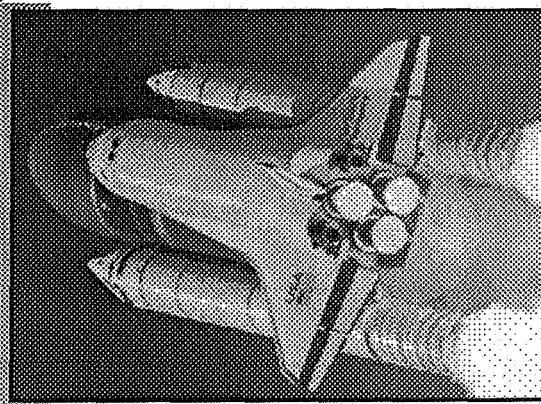
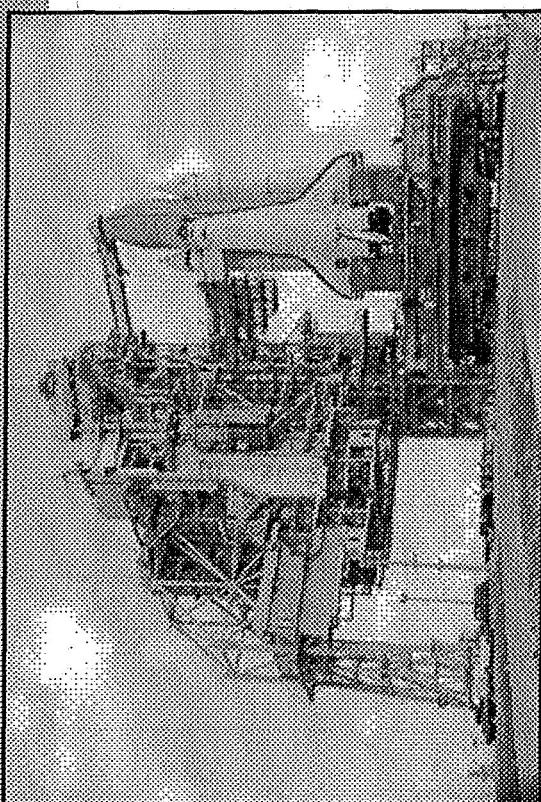
Traceability of Critical Parts



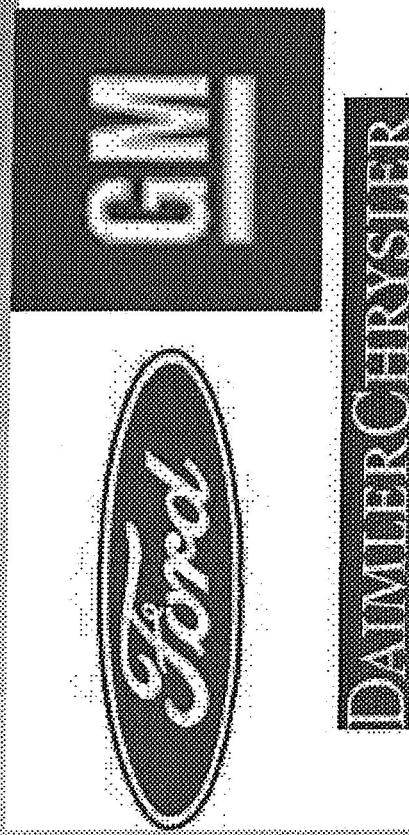
Traceability of Critical Parts



Traceability of Critical Parts

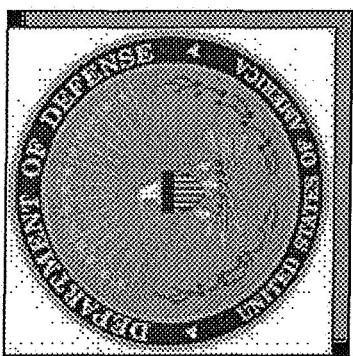


Traceability of Critical Parts Starts with Identification



*Part Numbers and Serial Numbers
Identify One Part From the Other*

*CAGE Numbers Identify One
Supplier from the Other*



Automatic Identification Used at Many Levels

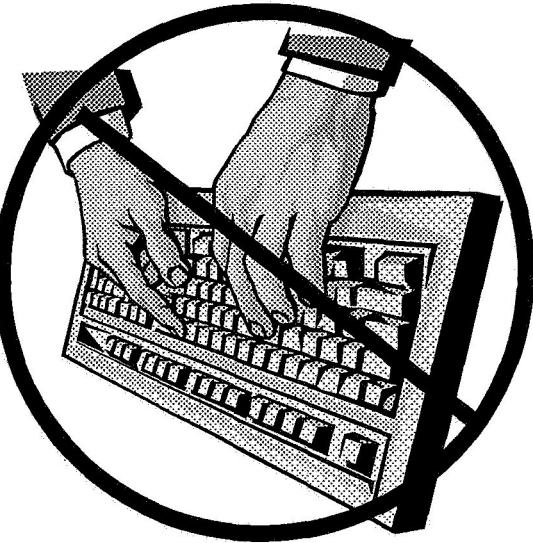
Bar Coded Labels That Are Adhered to or Printed on the Product

Direct Part Marked Visible Permanent Identification

Direct Part Marked Hidden Permanent Identification

RFID

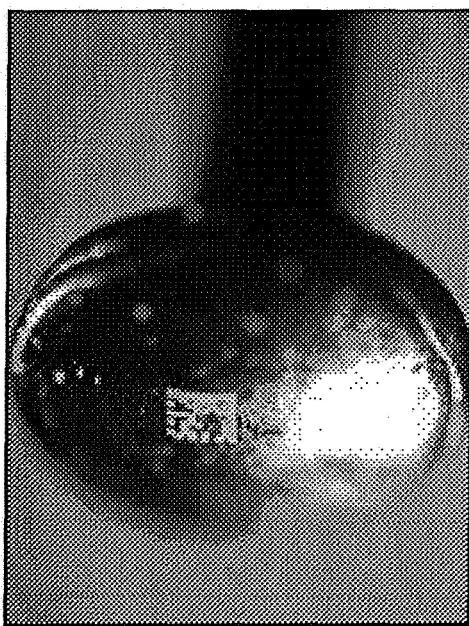
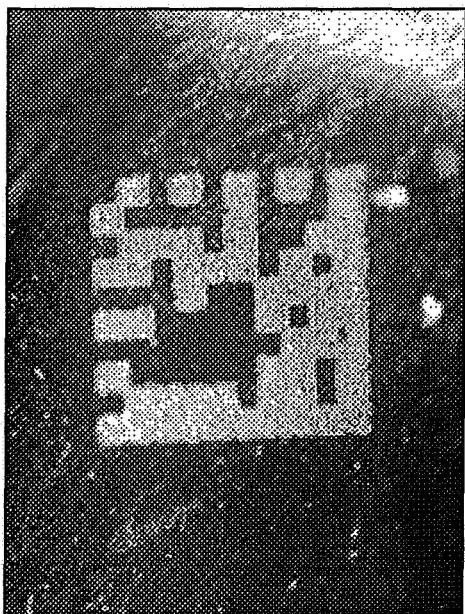
Nanocodes™



***All Technologies Must Work Together In the IT World....
Traceability Depends On Automatic Identification Working
With Automatic Communication For The Right Results***

Automatic Identification Choices

Bar Code
Labels
Are
Cheap...
Mature...
Reliable...
Widely Available
Technology



Above: 10x10 matrix symbol on the
head of a straight pin

***But If There Is Not Room for a Bar Code Label
or if a Permanent Mark Is Required... Use 2D***

Direct Part Marking

Direct Part Marking

NASA's Primary Emphasis

....Item-Level Traceability

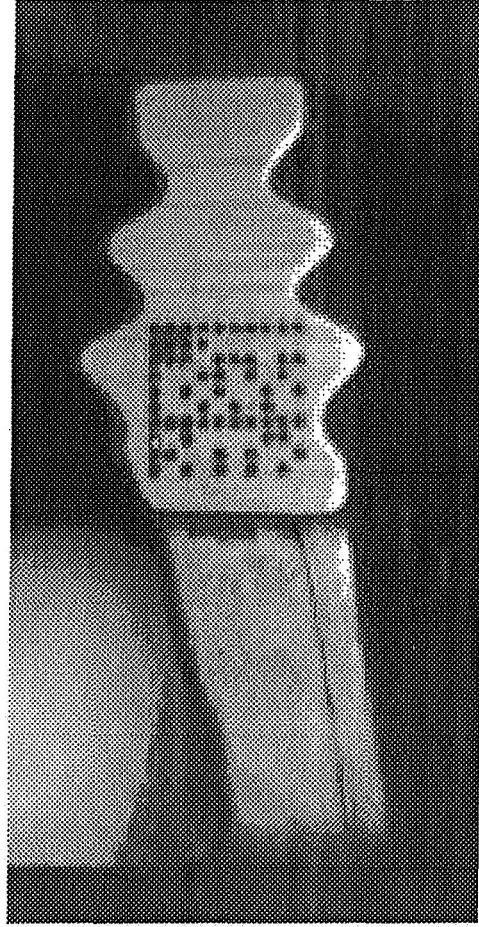
.....Track the Piece

Know the Pedigree

....Know who made it

....Know who marked it

....Know who stands behind it



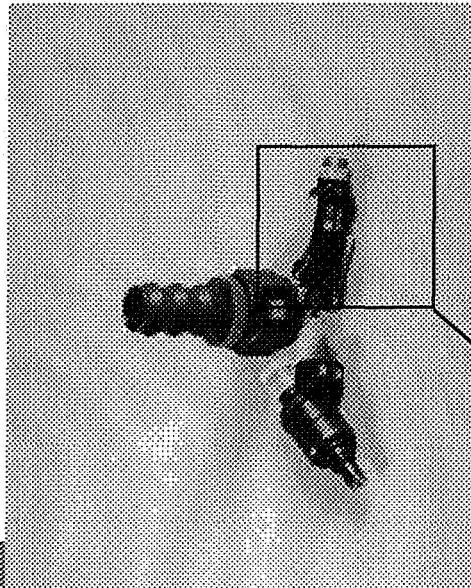
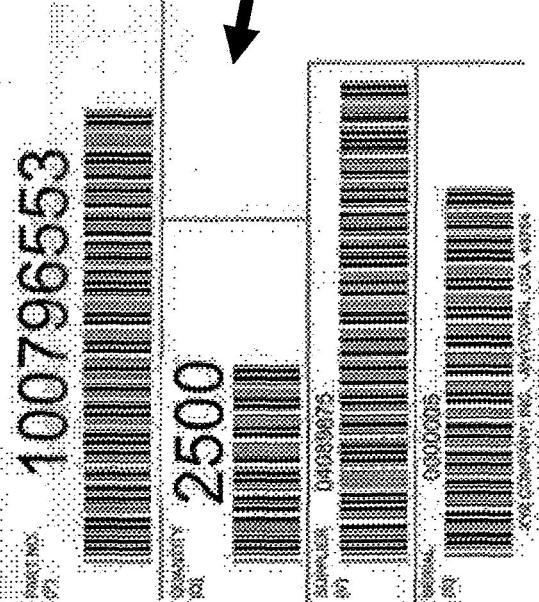
Above: 10x10 matrix symbol
on the side of a turbine blade

Lest We Forget

A Mark is a Controlled Defect

Properly Done—It Is a Flawless Imperfection

Automatic Identification Starting Points All ID Must Work Together

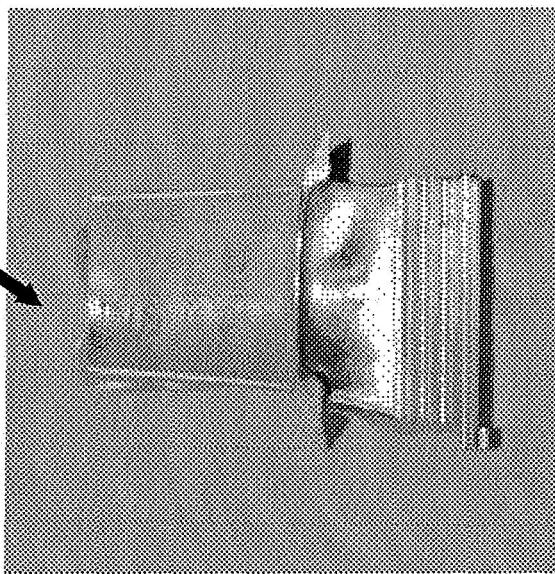


Bar Code

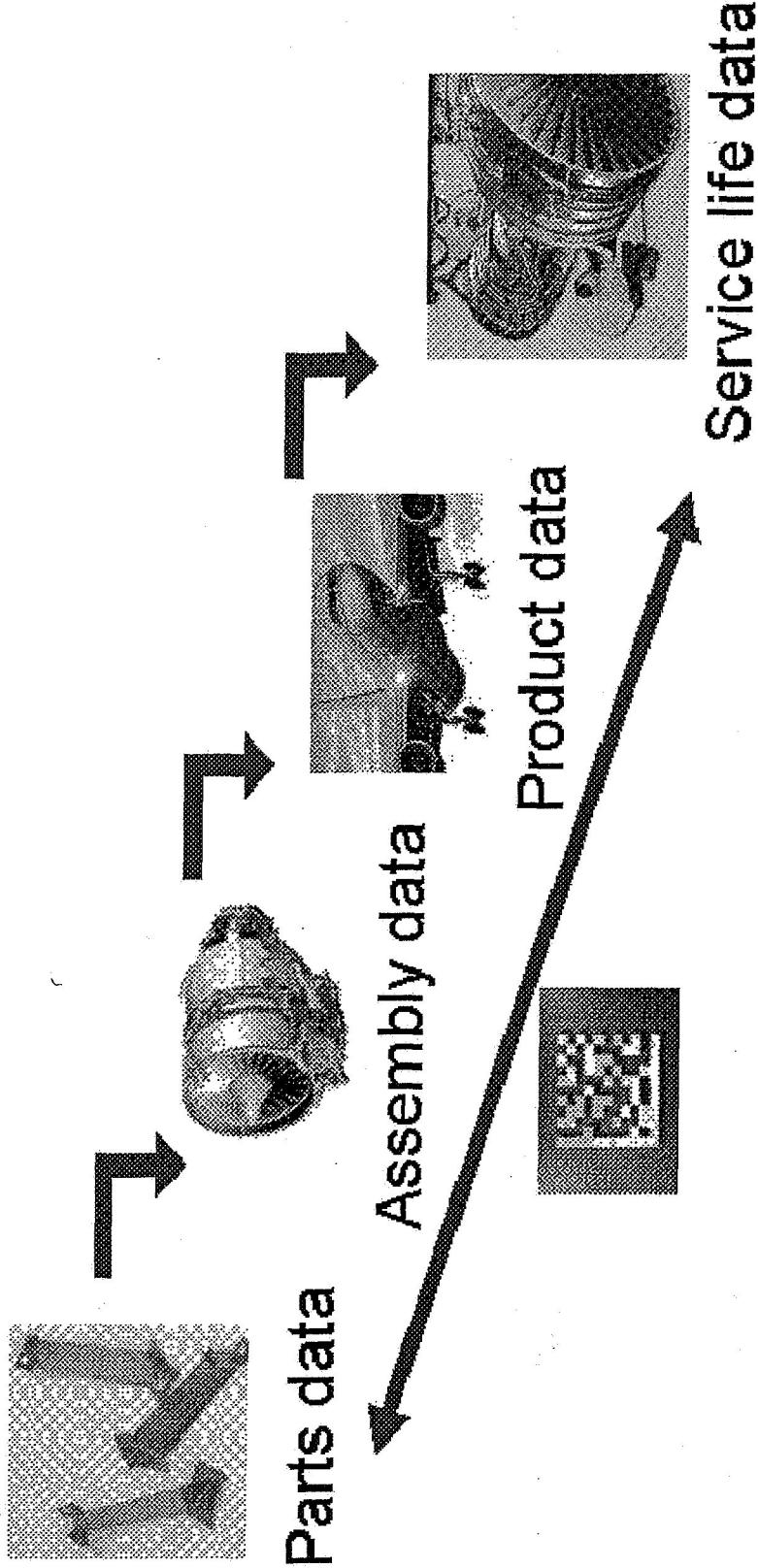
Data Matrix

Space Shuttle
Main Engine

Turbine Blade



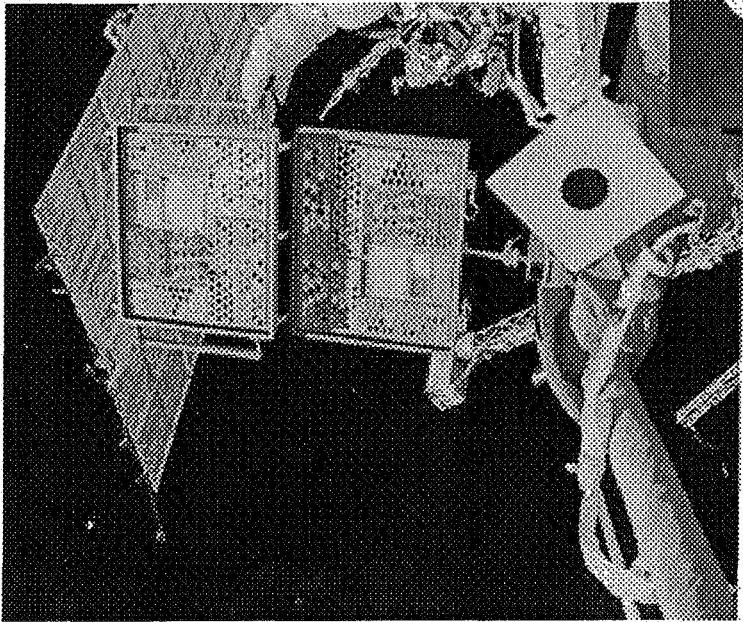
Direct Part Marking Enables Life Cycle Tracking



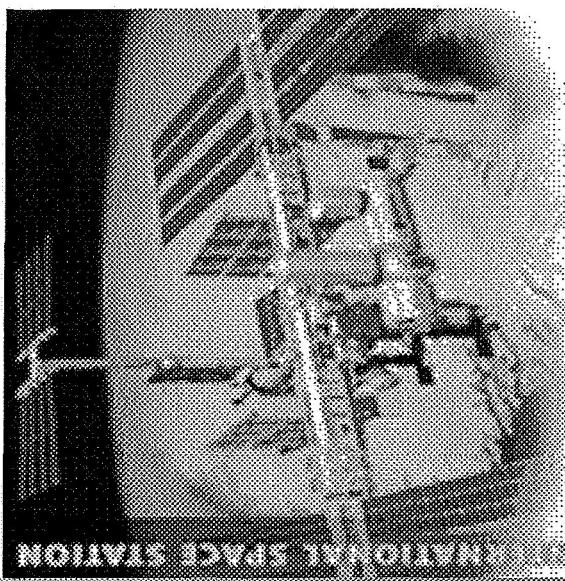
Data Matrix Codes Marked On The Parts Provide The IT Link

NASA Has Unique Marking Problems and Unique Testing Methods

The Columbia Accident Extended
The
Exposure
Period
To
4 Years



The Plan Was To Expose
The Samples to Space
For A Year...But

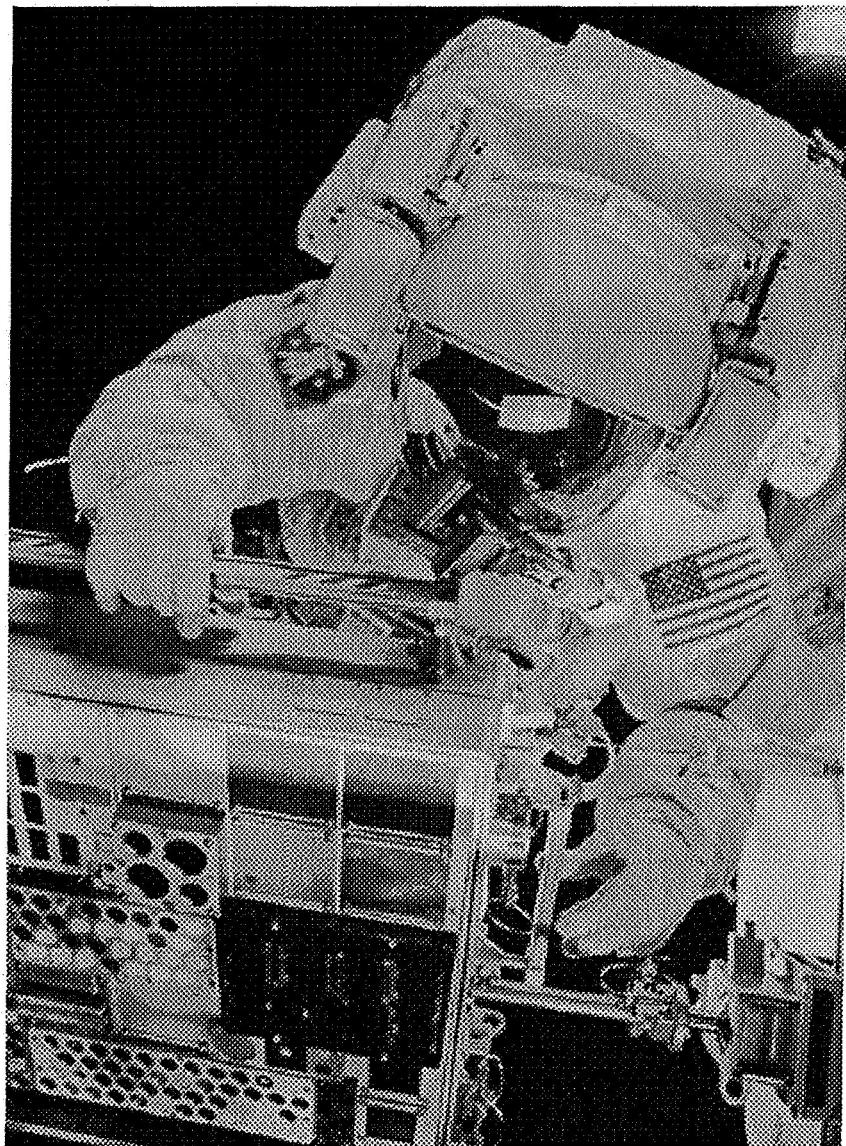


NASA Has Unique Retrieval Methods

The Astronaut Was
In The Vicinity and
Retrieved The
Experiment on First
Flight.

All Samples Looked Good
As New Except Copper
Coating Turned Green.

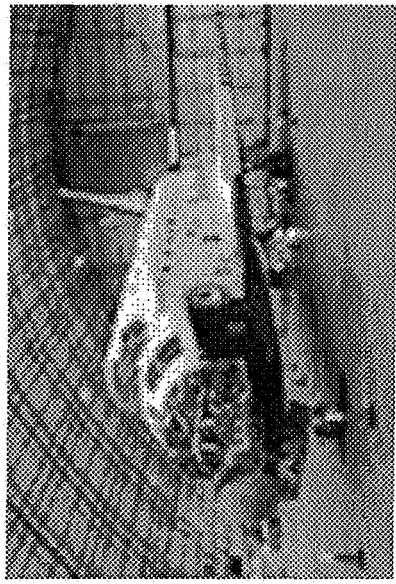
Micro Meteoroid Impacts
Noted on One Sample



NASA Tested Thermal Protection Tile Marking Method

Thermal
Protection
System
Tile

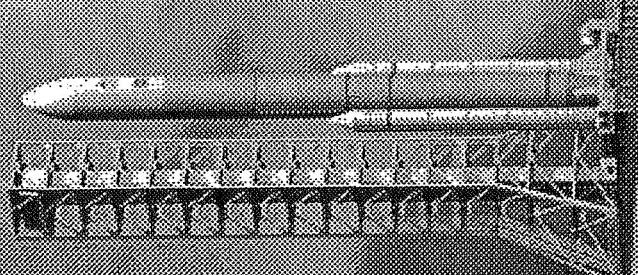
16 Times in
Space
on OV-103
(Discovery)



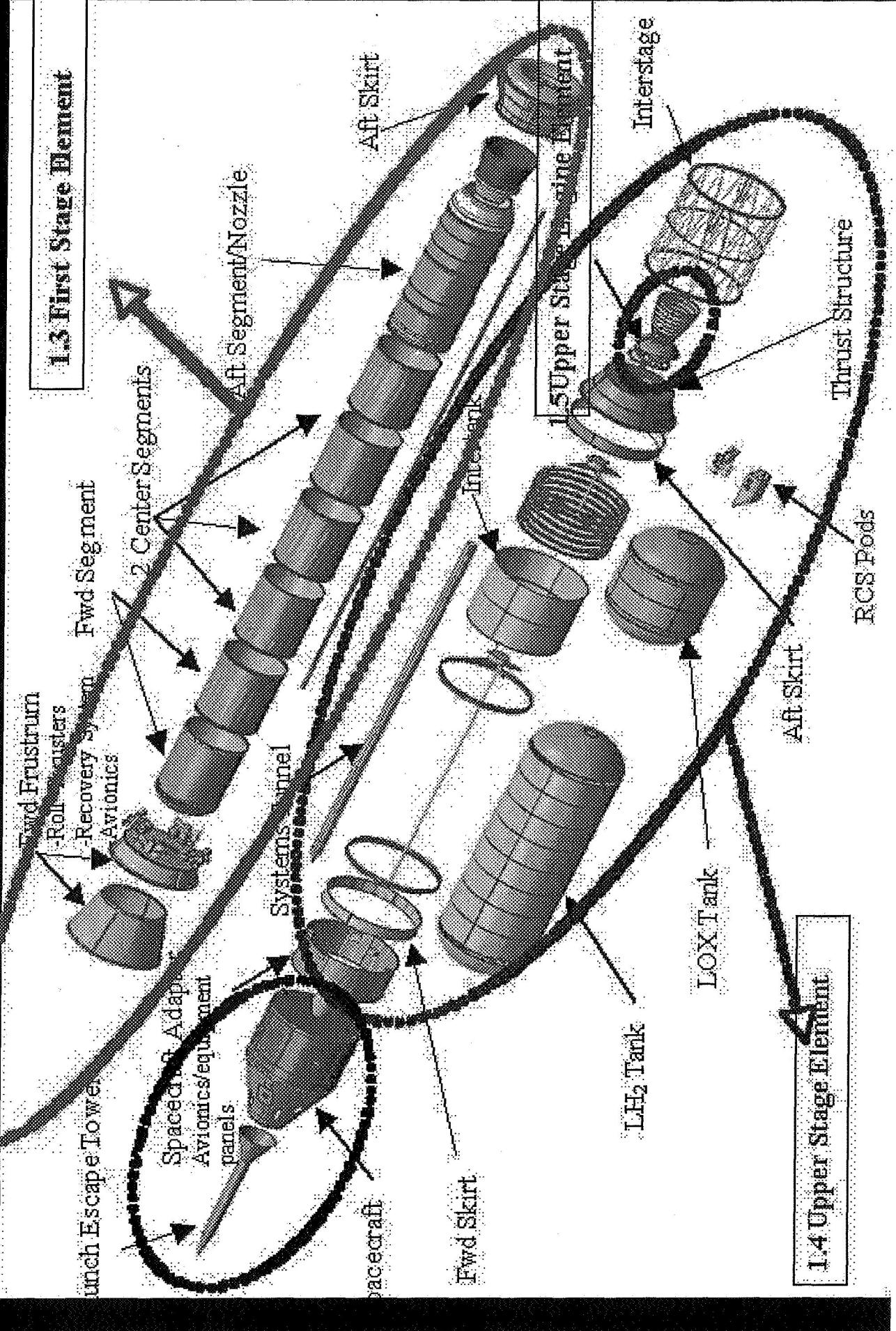
Looked Good
And
Readable

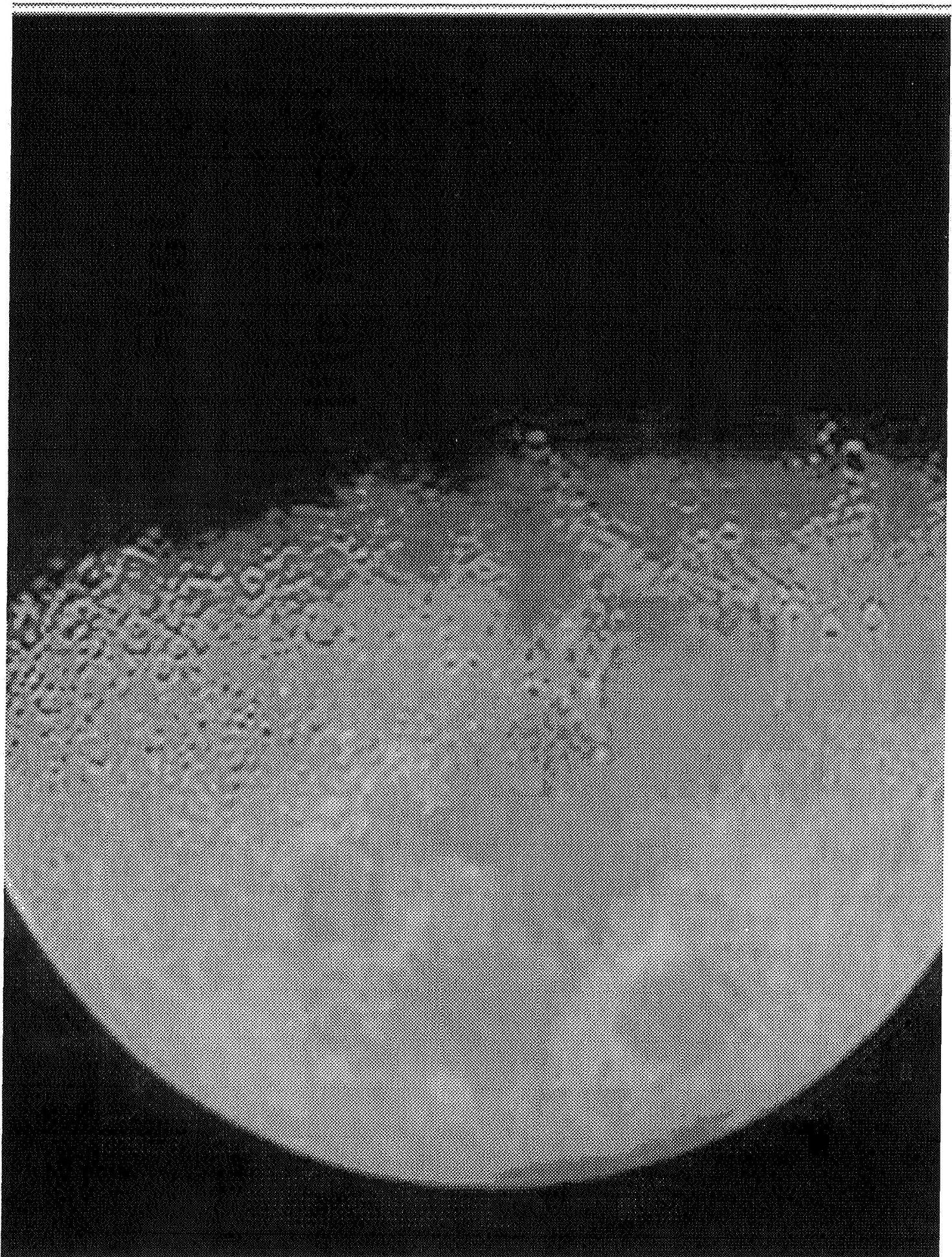
New Line

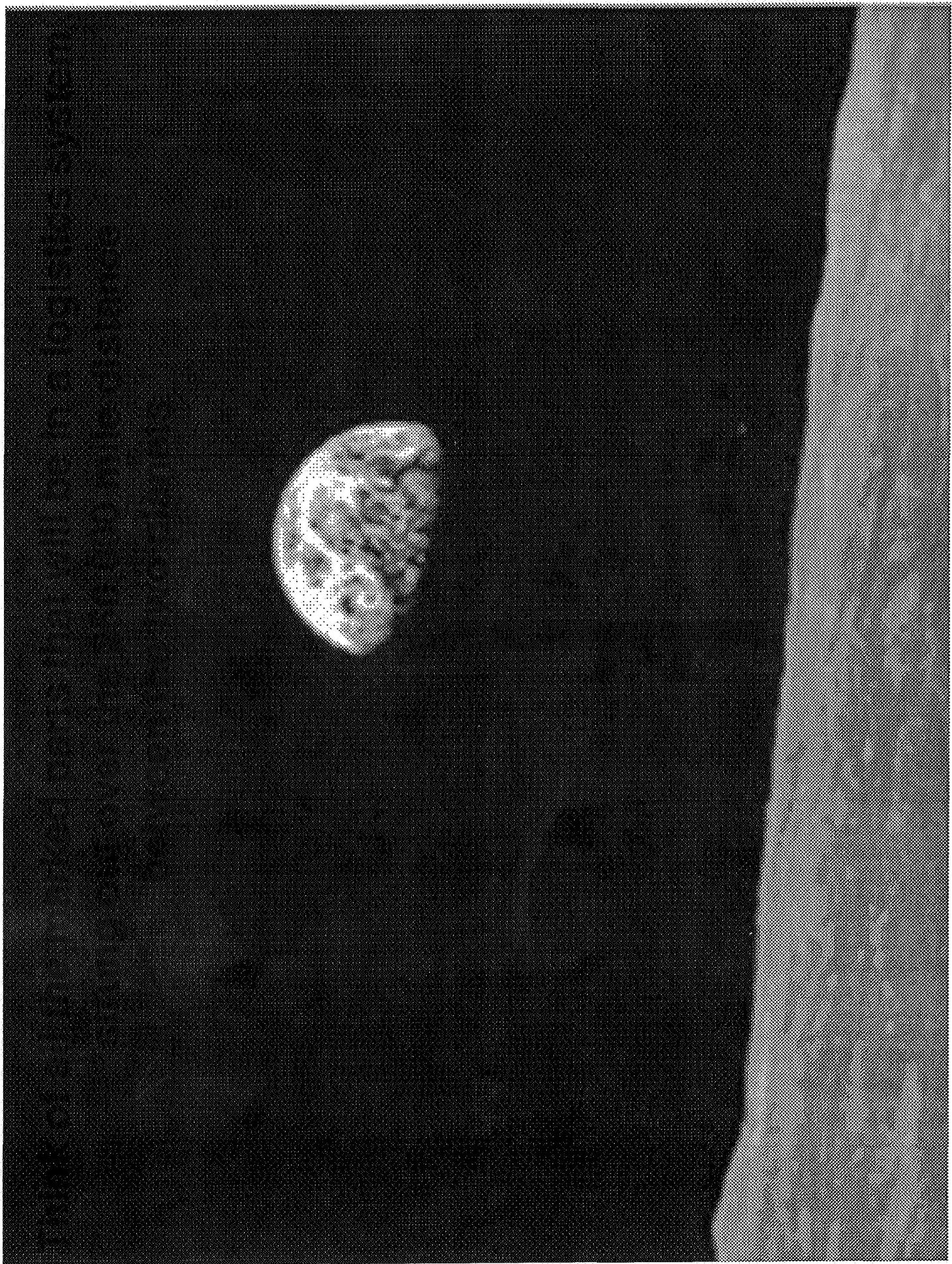
Sc



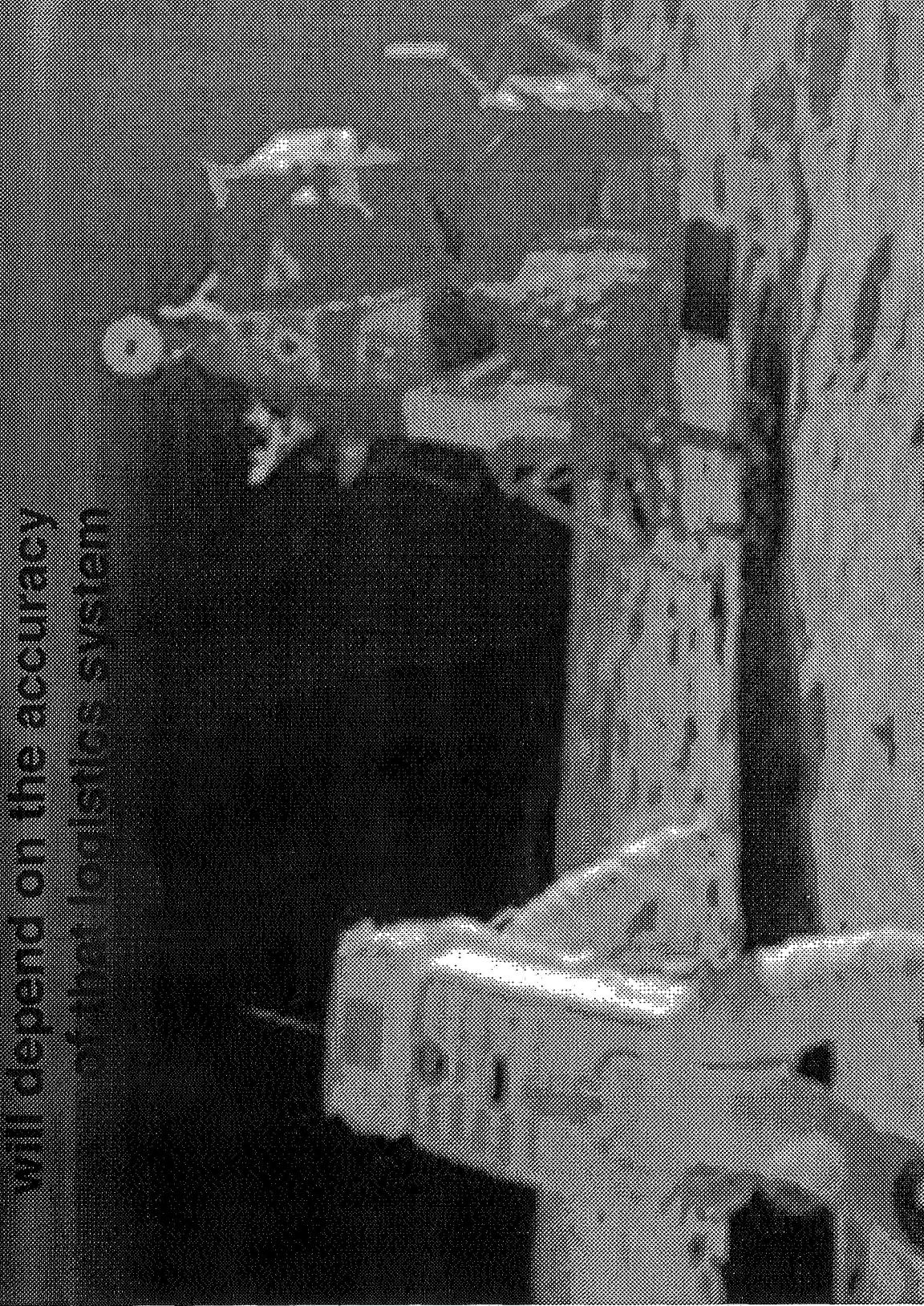
Crusader Launch Vehicle Configuration

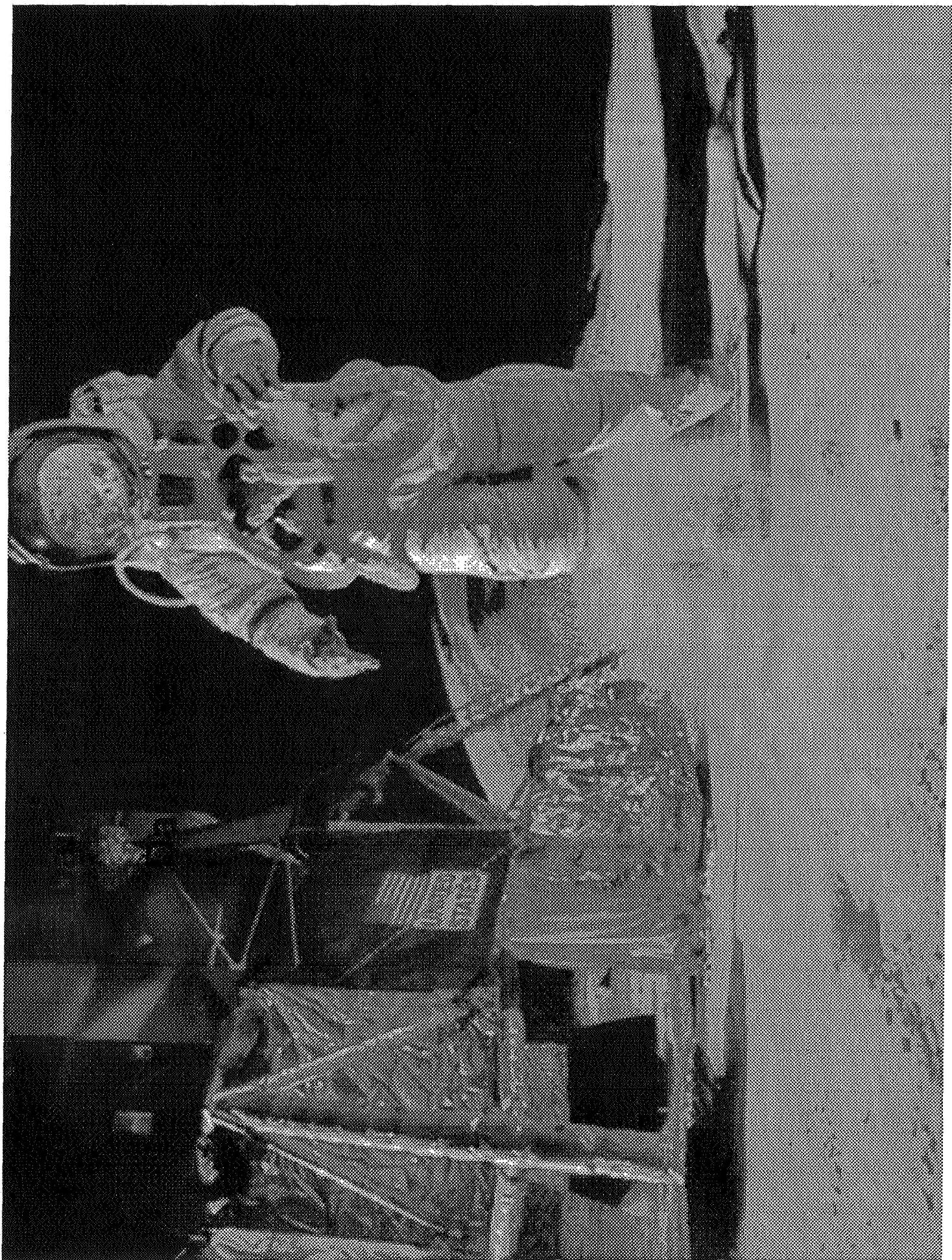


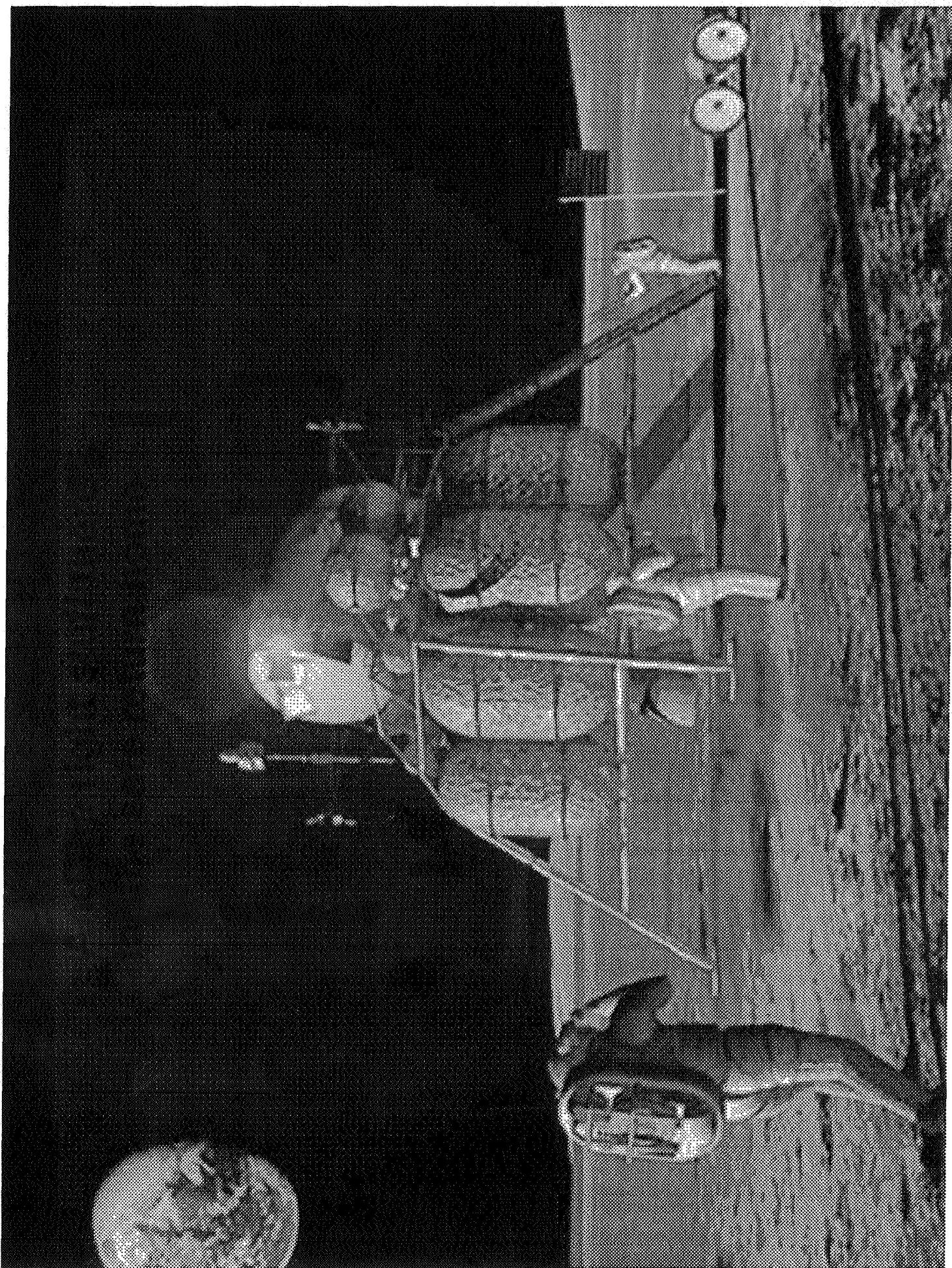


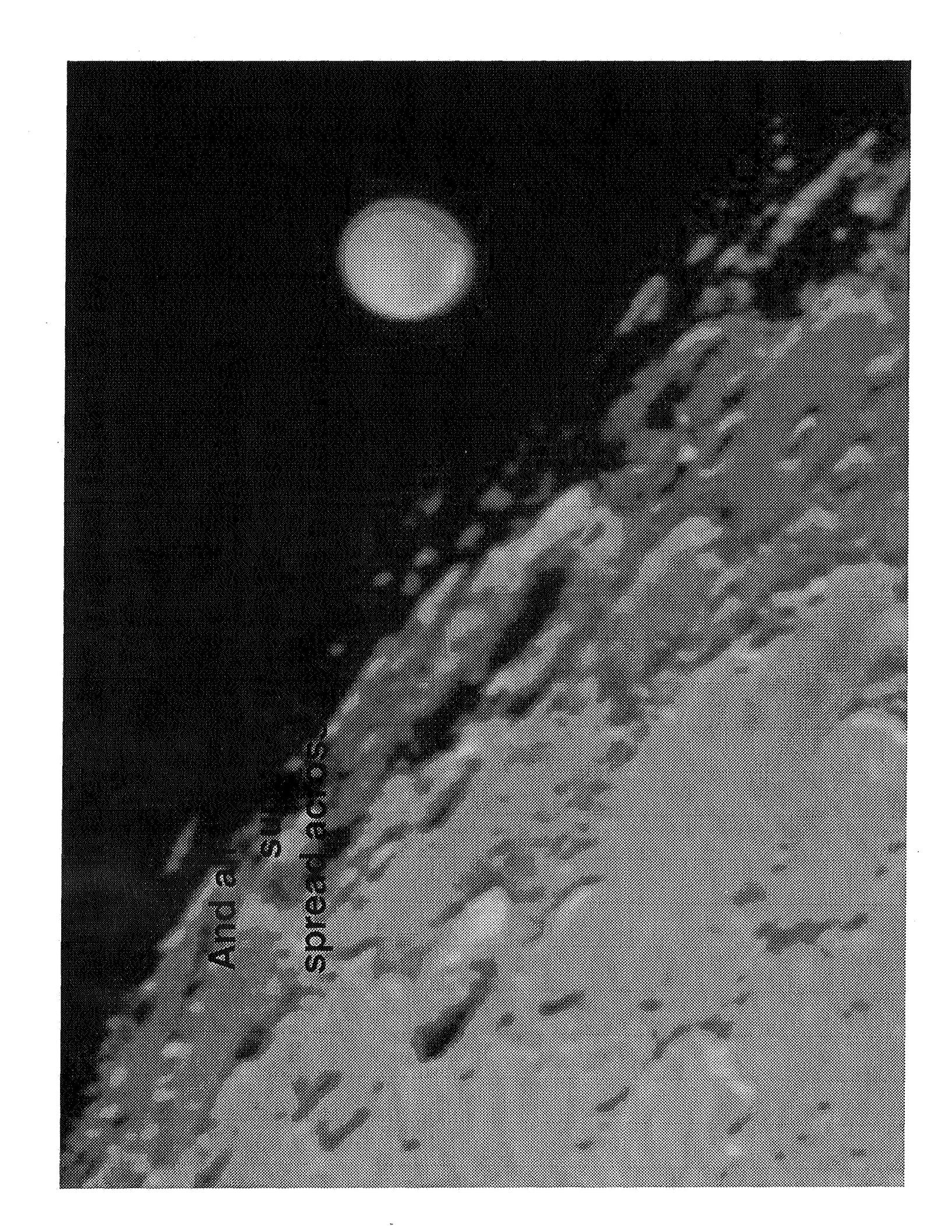


Our children's
lives
will depend on the accuracy
of our defense system

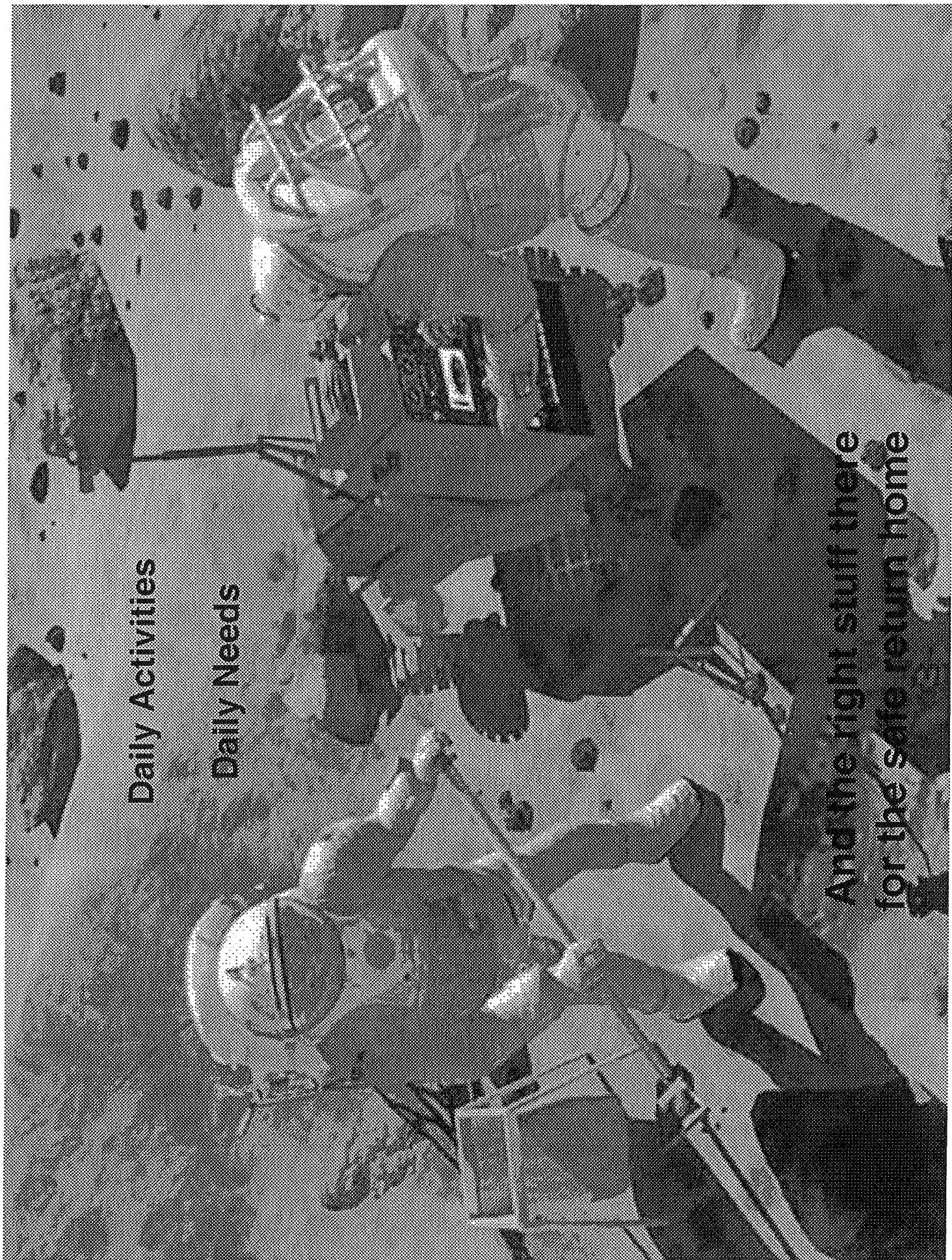








And a
spread across

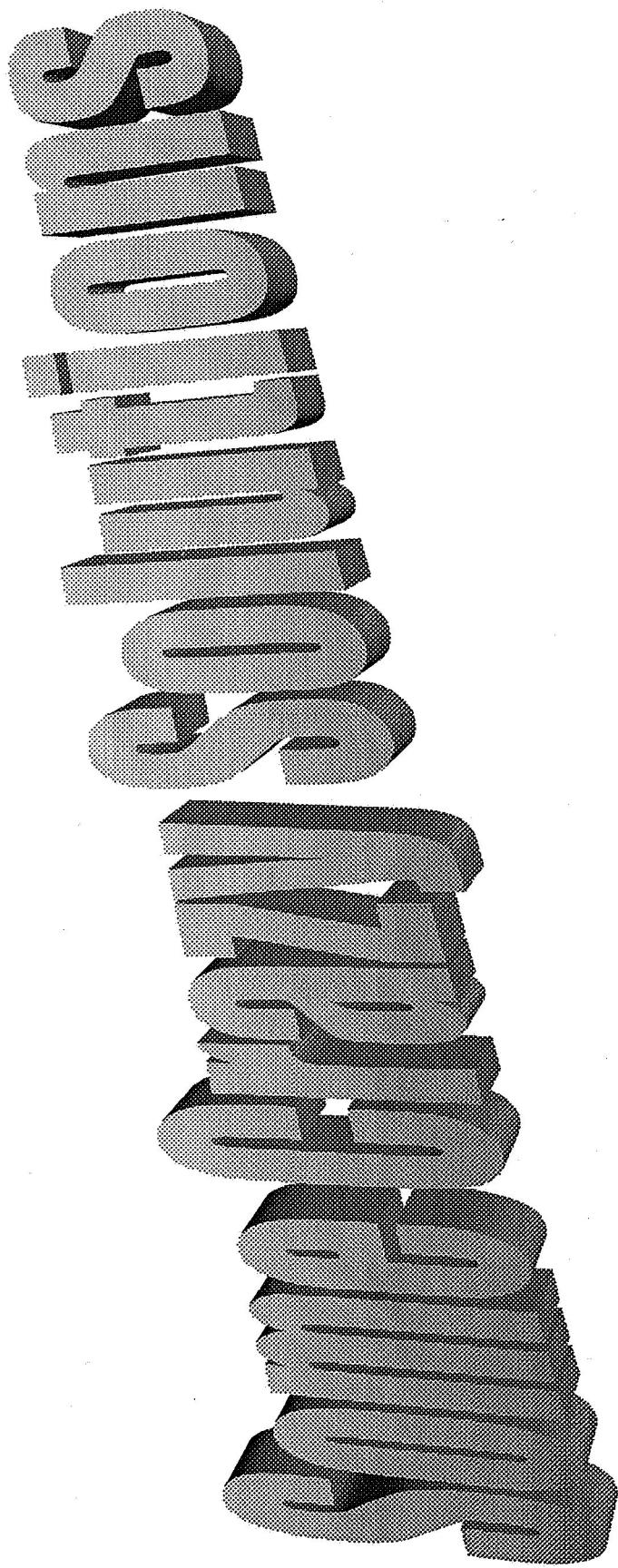


Daily Activities

Daily Needs

And the right stuff there
for the safe return home

Space Systems... There Are Some Direct Part Marking and Reading Problems



Product ID Problems That Required New Technology

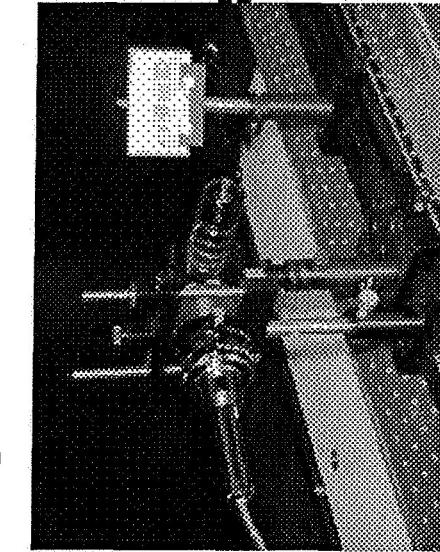
- No Contrast Marks
- Curved and Shiny Surfaces
- Distance Reads
- Mark and Scanner Both Moving Independently
- Symbols Covered with Paint
- Chemical Tags Not Recognized as Codes

Solutions for Visible Marks

One Reading Remedy...

New Pair of Glasses from Space Station

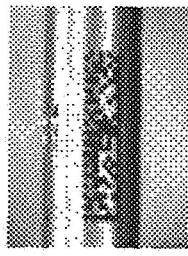
NASA Optical Scanner For Visible Marks



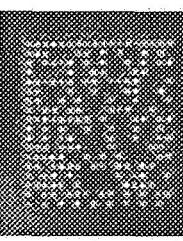
2'

20'

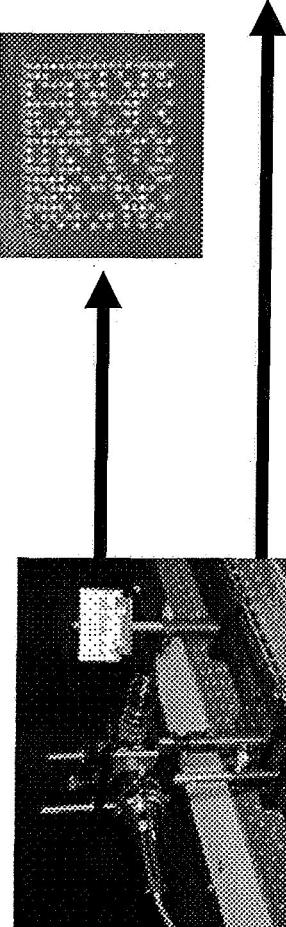
60'



No contrast mark
on smooth aluminum
at 30 degree angle



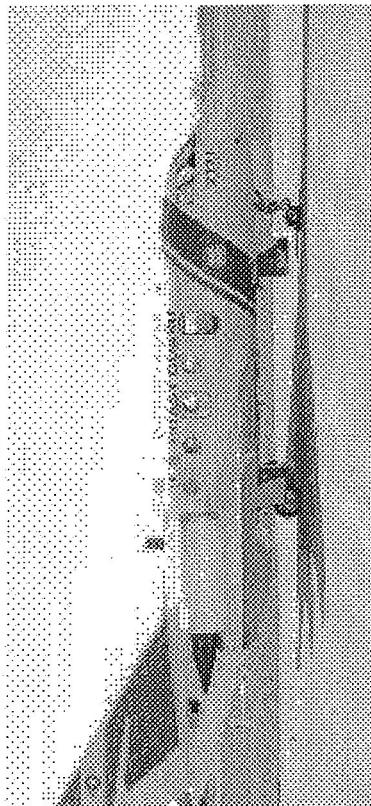
Shiny screwdriver



New Distance Capability Being Developed

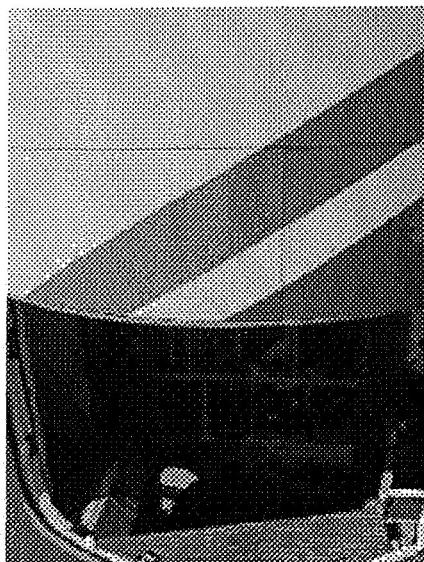
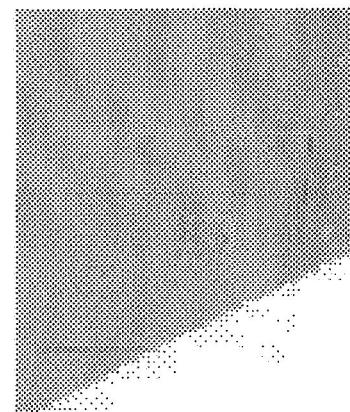
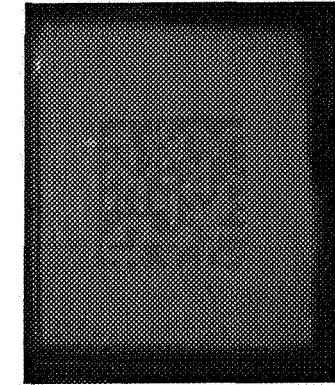
Solutions for the Painted Part ...Read through the Paint...

Magnetic



*Mark Survived
18 Months of
Coast Guard Duty*

Mark Decoded



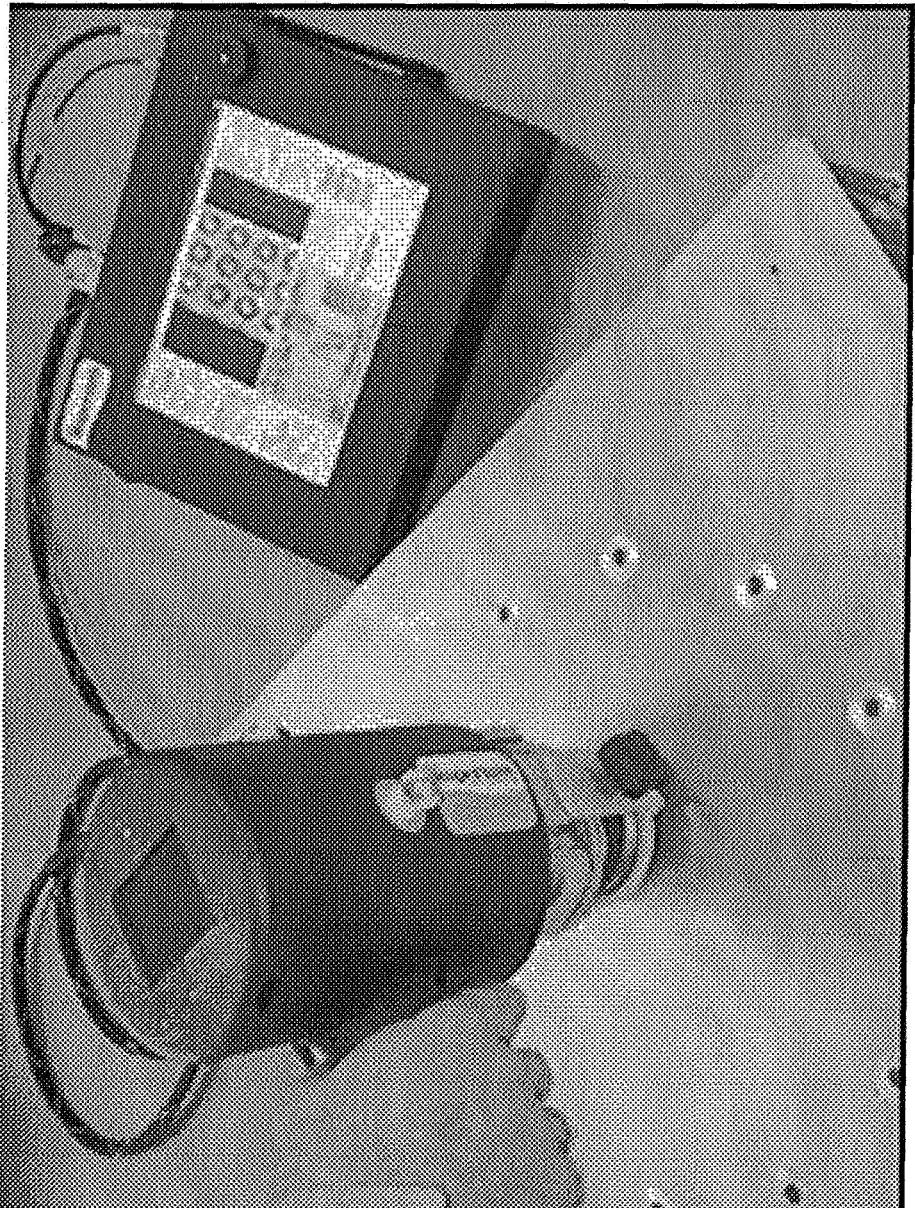
Solutions for the Painted Part

...Read through the Paint...

Reads through
6 Layers
of coatings

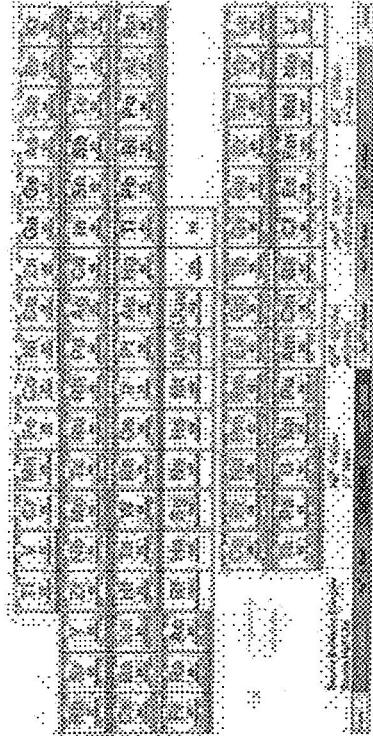
Ultrasonic

Detects density
and
surface height
changes

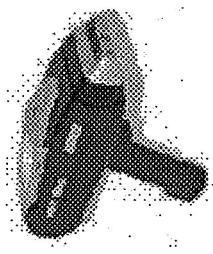


Solutions for the Unmarkable Part ...X-ray Fluorescence...

BarcodeTags™



=> **Conversion** <=

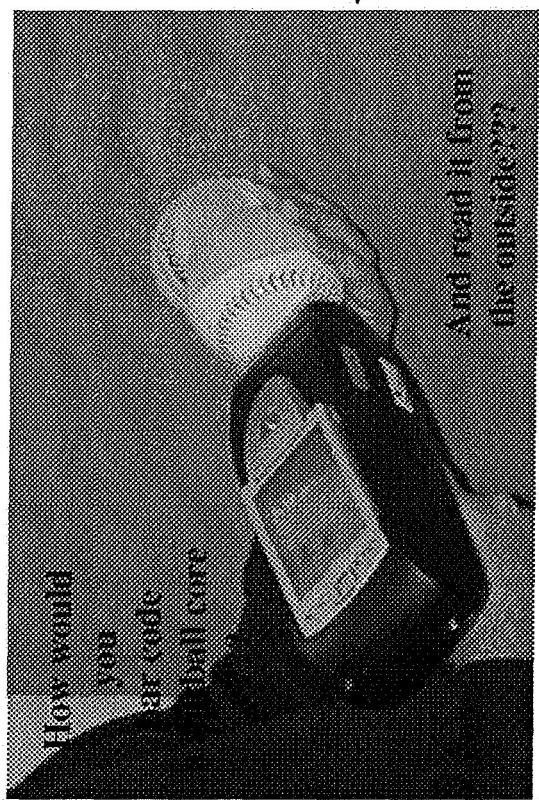


X-ray fluorescent
“chemical
bar code”

Software converts
to ASCII

and symbol of choice

Matches to the
Supplier Code



And read it from
the handheld

Solutions for the Unmarkable Part X-ray Fluorescence

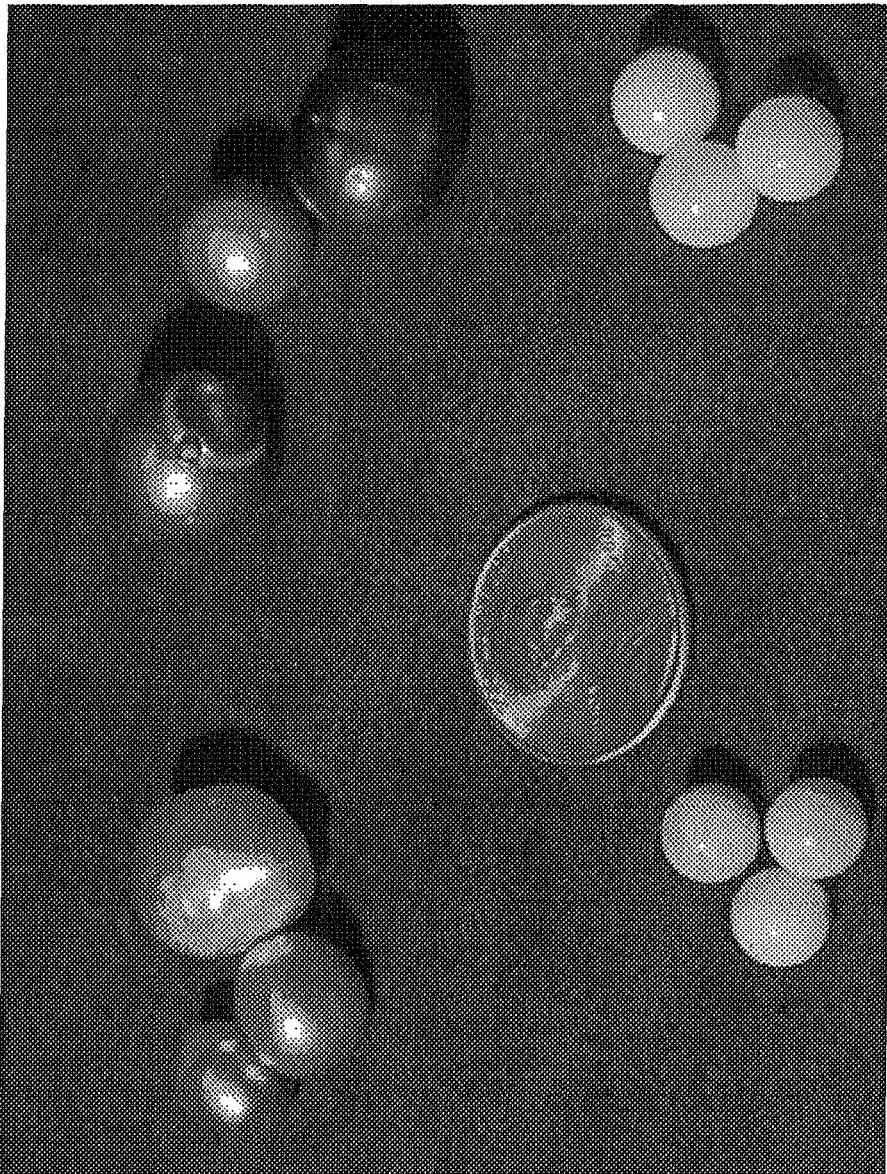
Nonstop™

*How would you
do it ???*

Bar code a cultured
pearl...
on the seed...
without a surface
change...
plant it in an oyster

Then read the bar code
two years later when
the pearl is formed....

Conversion =>



Y

Intrinsic Secret Identification



How does an OEM prove that the part that failed was not made by the OEM?

XRF authenticates the product

CAGE Code.....5 Element Tag

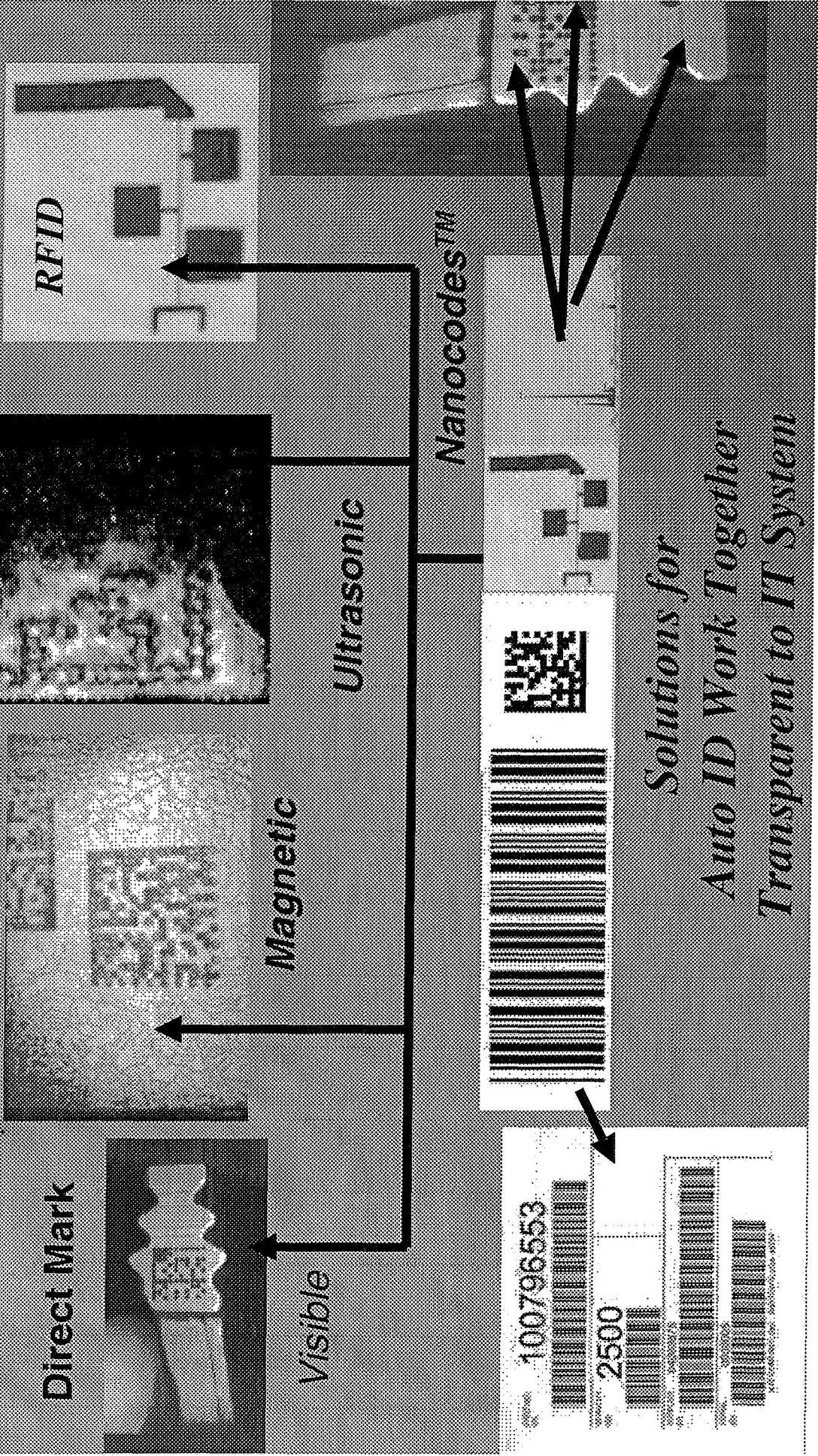
XRF converts formats and ties to bar and matrix codes

XRF converted format is transparent to IT systems

XRF Nanocodes could be file next generation expertise in this industry

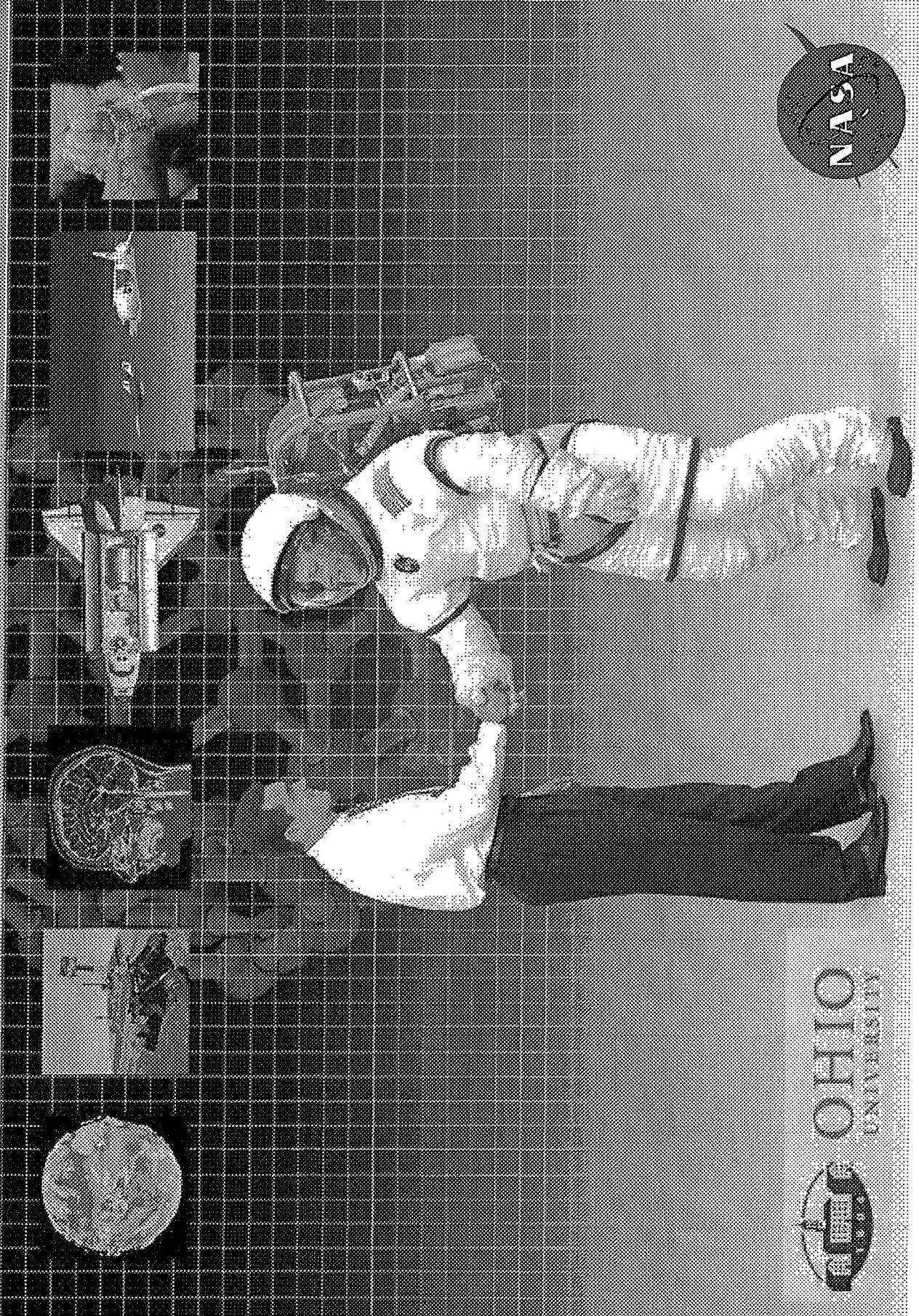
Product Validation and Authentication

Automatic Identification Fully Integrated
(temporary to permanent to intrinsic marks for routine to the most secure
product ID and validation matching)



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